YOUR CONSTRUCTION AND OPERATING QRP SOURCEBOOK

QRP Quarterly

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Winter 2010
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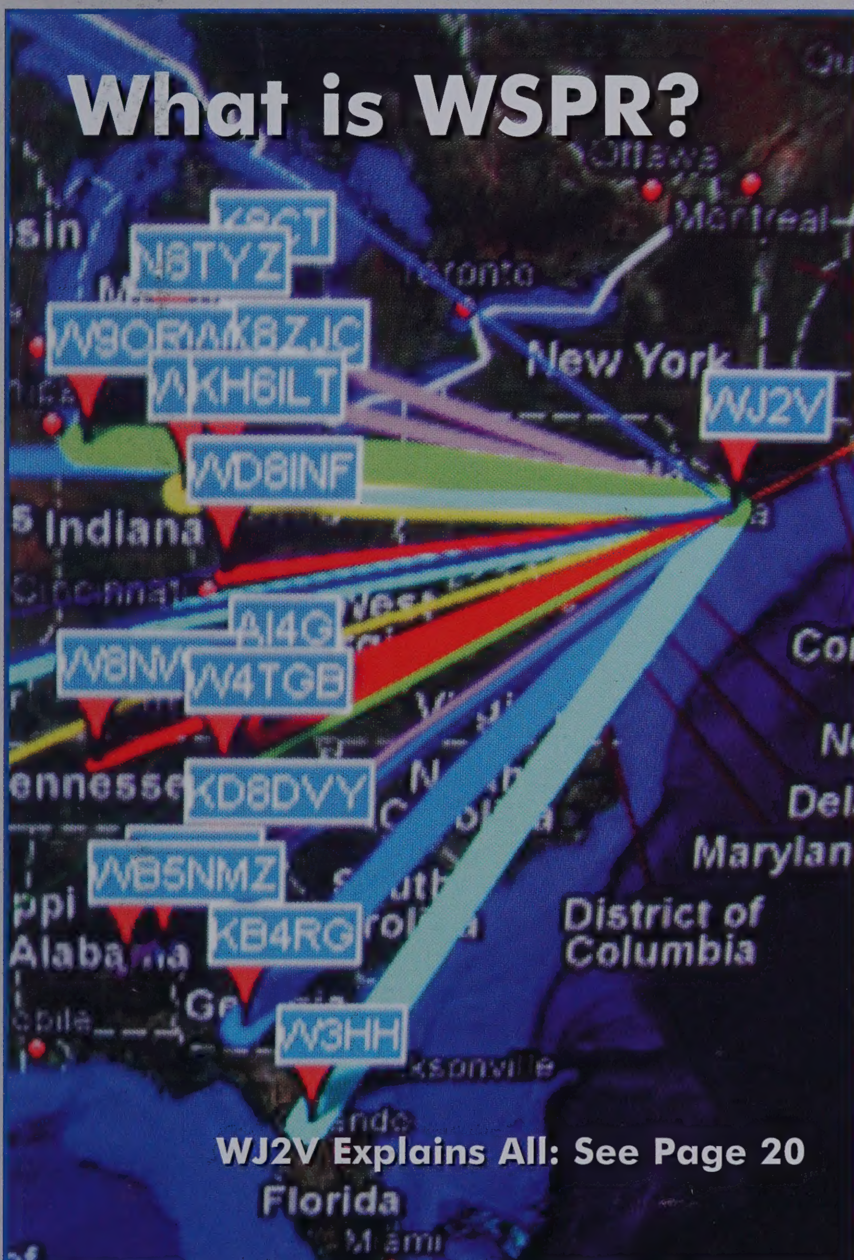

- Announcing FDIM 2010! Get the Story Inside...
- AE6TY Builds a Software-Defined QRP Radio
- KB3WK Provides a List of Available QRP Kits
- Read About N8ET's QRP CQWW CW Contest Experience
- Contest Results—
  2009 Fall QSO Party
  2009 Silent Key Memorial Sprint
  2009 VHF Sprint

QRP ARCI℠ is a non-profit organization dedicated to increasing worldwide enjoyment of radio operation, experimentation and the formation and promotion of QRP clubs throughout the world.

LDG ELECTRONICS

The #1 Line of Autotuners

NEW! Z-817

The Z-817 is the ultimate autotuner for QRP radios including the Yaesu FT-817(D). The Z-817 interfaces to the CAT port (ACC) on the back of the FT-817 radio with the provided cable. Tuning could not be simpler; one button push on the tuner is all that is needed and the Z-817 takes care of the rest. It will switch to PKT mode, transmit a carrier, tune the tuner, then restore the radio to the previous mode! 2000 memories cover 160 through 6 meters.

Of course, the Z-817 will also function as a general purpose antenna tuner with other QRP radios. Just transmit a carrier and press the tune button on the tuner. The Z-817 is powered by four AA internal Alkaline batteries (not included), so there are no additional cables required to use the Z-817. A coax jumper cable is also induced for fast hook up. Latching relays are used so that power consumption is Zero when not tuning allowing a set of batteries to last about one year. ***Suggest Price $129.99.***

SPECIFICATIONS

- *Up to 20 watts SSB, CW and digital modes.*
- *Latching relays for ultra low power consumption.*
- *Battery operated 4 x 1.5V Alkaline AA (not included).*
- *Built-in CAT port interface. CAT thru port for computer connection.*
- *2000 memories when used with FT-817 interface (200 memories for other radios).*
- *1.8 to 54 MHz coverage (continuous coverage for MARS)*
- *Tunes 6 to 600 ohms. (16 to 150 on 6M)*
- *SO-239 in and out connections for dipoles, verticals, beams, G5RV, OCF, Cobra, ect.*
- *Dimensions: 5.2"W, 4.6"D, 1.7"H. Weight: 13 ounces.*
- *Includes 1 foot CAT cable and 1 foot coax jumper.*

Z-11Pro

The original portable Z-11 was one of LDG's most popular tuners, accompanying adventurous hams to their backyards, or to the ends of the earth. Now meet the Z-11Pro, everything you always wanted in a small, portable tuner. Designed from the ground up for battery operation. Only 5" x 7.7" x 1.5", and weighing only 1.5 pounds, it handles 0.1 to 125 watts, making it ideal for both QRP and standard 100 watt transceivers from 160 - 6 meters. It will match dipoles, verticals, inverted-Vs or virtually any coax-fed antenna. All cables included. ***Suggested Price $179***

NEW! Z-100Plus

LDG's popular Z-100 economy tuner is now the Z-100Plus. Still small and simple to use, the Z-100Plus sports 2000 memories that store both frequency and tuning parameters. It will run on any voltage source from 7 to 18 volts; six AA batteries will run it for a year of normal use. Current draw while tuning is less than 100ma. The Z-100Plus now includes an internal frequency counter so the operating frequency is stored with tuning parameters to make memory tunes a blazingly fast 0.1 seconds; full tunes take an average of only 6 seconds. ***Suggested Price $159.99***

Call or visit your favorite dealer today!

Visit www.ldgelectronics.com for a complete dealer list.

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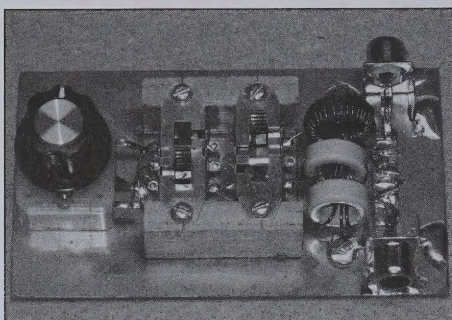
LDG

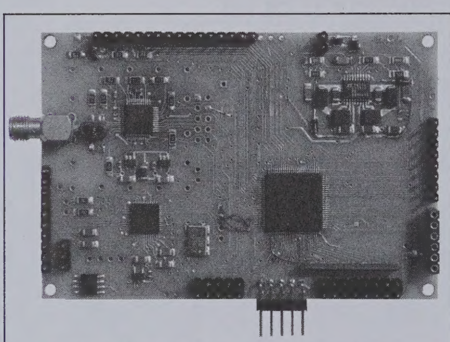
Table of Contents

QRP Quarterly

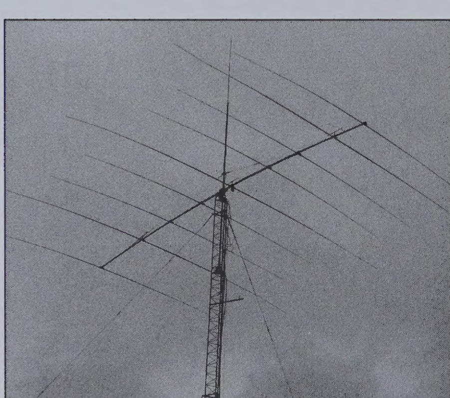
Volume 51 Number 1 – Winter 2010



page 9



page 32



page 46

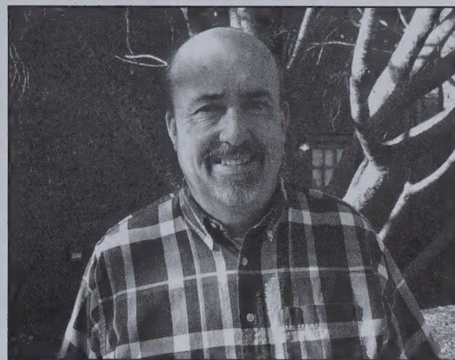
Technical Articles

The Joy of QRP

The World of QRP ARCI

From the President

Ken Evans—W4DU president@qrparci.org



As I write this, we are about two weeks away from putting 2009 to bed. Another year is just about gone. My family is doing well and we are especially glad that our son-in-law returned safely from Iraq and is in the process of retiring from the Army. All children and grandchildren are healthy. We added to the ham portion of the family as our 13 year old grandson is now KJ4PQQ!

On the radio front, I had a good run in the QRP ARCI Fall QSO Party—at least good enough to place first in the North Georgia QRP Club competition. I am finally in process of getting on LOTW. Two antennas were added in the back yard. New modes and technology were explored with QRSS, WSPR as well as SDR. The hobby keeps finding new ways to hold our interest.

The club had a successful year in 2009. We had another fun filled FDIM; we made improvements to the awards program; had representation at five major hamfests; sponsored numerous sprints and contests; as well as publishing the QRP Quarterly and maintaining an informative user friendly web site. We grew to over 2500 active members. Each year we seem to make incremental improvements to help foster interest in QRP.

The activities of the club don't simply happen. Our volunteer staff puts in the extra time to bring these things together for all of our enjoyment. It also took every one of you to make all this fun stuff happen. Your participation in the on the air sprints and QSO parties; the awards program; attending QRP events like FDIM, Ozarkcon and Pacificon; all of this promotes QRP and makes the hobby more enjoyable for all of us. It's also the spouses and families that give up their time with you so you may participate. Yes, it takes a community to support a great amateur radio club. And we have a great community within QRP. I thank all of you for the time and effort spent in supporting QRP ARCI.

As we move into 2010, we will have the terms of three members of the Board of Directors expire. You'll find information in this issue on how to serve in this capacity. We are looking into ways to further improve the value in active membership (those that subscribe to the QQ are defined as active members by the club by-laws). One way to do this is to make the QQ available to more amateurs. Stating in January 2010, we will implement a process so that visually impaired members will receive the magazine in a screen readable format. There is a short announcement about this in this issue. If you or a friend needs the QQ in a screen readable format, please send an email requesting information to: access@qrparci.org. There is no extra charge for this, it will be a benefit of membership.

Have a great 2010. I hope to see you on the air, at a hamfest or FDIM 2010.

—72, Ken Evans, W4DU

QRP Quarterly Accessible to Visually Impaired

Starting in January 2010, the *QRP Quarterly* will be available to visually impaired members in a screen readable format. There is no extra charge for this service beyond the normal subscription fees. If you, a friend or a family member needs the *QQ* in this format, please send an email requesting information to access@qrparci.org. This announcement will be placed on the club web site http://www.qrparci.org/. In addition, when a person joins or renews, they receive a confirmation email. This information will be in each of those emails. This is a new process that undoubtedly we require some adjustments. Please be patient as we work out any kinks. In the mean time, enjoy the *QQ*. ●●

QRP ARCI News

Worked All ARCI Challenge

By now, you should have your entry ready or have sent it in. The deadline has been extended to February 15, 2010. This challenge was to see which member (or non-member) could work the most ARCI members and collect their numbers between August 1 and December 31, 2009. How did you do? Make a list of callsigns and the associated ARCI number and send to W4QO@qrparci.org by Feb. 10 to enter this contest. Postal entries are also welcome at W4QO's QRZ address. Please have your entry reviewed by two General Class or higher hams who authenticate your entry via selected log checking. By affixing their calls to your entry, they will be certifying this entry as with all QRP ARCI awards using the following statement:

GCR Certification—We, the undersigned, on the dates affixed next to our signatures, have examined the log records assembled as proof for earning this award, and affirm that the claims of the applicant are valid and true.

First place will receive a $100 Gift Credit for Elecraft products, second place gets a $50 Gift Credit for a purchase from MFJ. If the purchase is less than the value of your winning, you will receive a refund equal to the full value of your purchase. Oh, and third place winner gets a one year extension to their ARCI membership. The way this will work is: You will receive a signed certificate to you (a winner). Then, when you make a purchase, you will send a signed copy (scanned is acceptable) of the sales receipt to W4QO who will have a "refund" check sent to you by the ARCI treasurer.

So get your logs out and make a log extract showing: Date, Time, Callsign, Band, and QRP ARCI number. Let's see who wins this Worked All ARCI Challenge. Remember the deadline for entries is Feb. 15, 2010.

For full details, go to: http://www.qrparci.org/content/view/8350/132/ And now that you have more ARCI numbers, why not apply for one of the various levels of the Worked All ARCI award? See: http://www.qrparci.org/content/view/22/116/

—Jim Stafford, W4QO

Call for nominations to the QRP ARCI Board of Directors

The terms of three members of Board of Directors of QRP-ARCI will be completed on June 30, 2010. The three board members whose terms are expiring are Jay Bromley, W5JAY; John Cumming, VE3JC; and Hank Kohl, K8DD. This is an opportunity to step up and work for the club as a member of the Board of Directors. Even if the three members whose terms are expiring choose to throw their hat in the ring for re-election, now is the opportunity for YOU to step up and offer your services to the club.

The Board meets at least once every year at Dayton. However, most of the business is done over the Internet and all current BOD members will agree that the workload is not great. It is not essential that you get to Dayton for the meeting, though it is a great opportunity to join in at FDIM. It is essential that you have Internet access and beneficial, though not essential to have broadband access.

If you or anyone you know is interested in running for election to the Board please send a brief resume to Ken Evans, W4DU at the email address below with a copy to Kathy Bromley, WQ5T. Nominations must be received by March 15, 2010. All nominations will be reviewed (per the QRP ARCI by-laws) and qualifying nominations published in the spring 2010 *QRP Quarterly* for a vote. The club by-laws state that any person nominated for election to the Board of Directors must have been an active member* of the club for the two years prior to nomination.

Ken Evans, W4DU—President: President@qrparci.org
Kathy Bromley, WQ5T—Vice President: vp@qrparci.org

**Active member definition from the by laws: Active Member—participates whenever possible in Club functions, meetings, contests and other activities; subscribes to the* QRP Quarterly *magazine. Note—active members maintain voting rights by subscribing to the* QRP Quarterly.

QRP Hall of Fame

It is a new year and the time has come for the call for nominations for election to the QRP-ARCI "QRP Hall of Fame."

You can submit either postal mail or internet nominations via e-mail but they must include the following information.

Name & Call of person nominated
Name & Call of person making the nomination.

A full description of why you think your nominee should be in the QRP Hall of Fame (HOF) is needed. Remember the voting body may not know this person and you must convince them that the person is worthy. Things such as "John Doe is a great guy and always helps out at the club" will guarantee he is rejected. Be specific in your recommendation and try to persuade as to why your person should be in the HOF.

The voting body consists of the QRP ARCI Board of Directors, President, Vice-President and last eight members inducted into the Hall of Fame. Nominations may be submitted by anyone, whether a member of the QRP ARCI or not. Similarly, membership in QRP ARCI is not required for someone to receive the honor, since this is an award to recognize those who have made great contributions to the QRP community, not just to the QRP ARCI.

If no nominations are received or the nominee(s) receive(s) less than the required 2/3 vote there will not be an induction at Dayton for 2010. The BOD is adamant that it is not a requirement that we will have an induction. A list of the current members of the HOF is included with this announcement.

Please forward your nominations to BOTH President QRP president@qrparci.org AND to the Vice President vp@qrparci.org. Nominations in writing should be sent direct to Kathy Bromley, WQ5T and I at the following addresses:

Chuck Adams, K5FO (1998)	Dieter "Diz" Gentzow, W8DIZ, (2005)
Brice Anderson, W9PNE (1996)	Paul Harden, NA5N (1999)
Rich Arland, K7SZ (2002)	Wes Hayward, W7ZOI (1996)
Dave Benson, NN1G (1999)	Doug Hendricks, KI6DS (1997)
Harry Blomquist, K6JSS (2008) (silent key)	George Heron N2APB (2001)
Fred Bonivita, K5QLF (2007) (silent key)	Martin Jue, K5FLU (2009)
Michael Bryce, WB8VGE (2000)	Bill Kelsey, N8ET (2004)
Wayne Burdick, N6KR (1998)	Ian Keyser, G3ROO (2004)
George Burt, GM3OXX (1996)	Hank Kohl K8DD (2007)
Rick Campbell, KK7B (2009)	Jim Kortge, K8IQY (2002)
Jim Cates, WA6GER (1998)	Roy Llewellyn, W7EL (1992)
L. B. Cebik, W4RNL (1999)	Rick Littlefield, K1BQT (1996)
Arnold (Arnie) Coro, CO2KK (2003)	Tony Parks, KB9YIG (2009)
Mike Czuhajewski, WA8MCQ (1997)	Dick Pascoe, GØBPS (1997)
Tom Davis, K8IF (1996)	Randy Rand, AA2U (1992)
Doug DeMaw, W1FB, (1992) (silent key)	C. F. Rockey, W9SCH (1996)
Ken Evans, W4DU (2008)	Eric Schwartz, WA6HHQ (2005)
Rev. George Dobbs, G3RJV (1992)	Hans Summers, GØUPL (2009)
James Duffy, KK5MC (2007)	Gus Taylor, G8PG (1998)
Joe Everhart, N2CX (2000)	Steve Weber, KD1JV (2004)
Graham Firth, G3MFJ (2003)	Adrian Weiss, WØRSP (1996)
Tony Fishpool, G4WIF (2003)	Peter Zenker, DL2FI (2001)

Members QRP ARCI Hall of Fame as of January 2010

Ken Evans, W4DU
848 Valbrook Ct.
Lilburn, GA 30047
USA

Kathy Bromley, WQ5T
3424 Brooken Hill Drive
Fort Smith AR 72908-9254
USA

The closing date for nominations is March 1, 2010. When a nomination is received, a confirmation e-mail or letter will be sent to the person making the nomination. If you nominate someone and do not receive a confirmation, we did not receive it. You will need to receive a confirmation to insure your nominee will be considered.

Ken Evans, W4DU
President: QRP ARCI

Kathy Bromley, WQ5T
Vice-President: QRP ARCI

Four Days in May 2010!

(Full FDIM information begins on page 28)

When? May 13th, 14th, 15th, 16th, 2010

Speakers:

- Jim Everly, K8IKE
- Jay Slough, K4ZLE
- George Dobbs, G3RJV
- Hans Summers, GØPDL
- B. Scott Andersen, NE1RD

Topics will include QRSS; DXpeditions for the QRPer; Test Equipment; Homebrew receivers; along with some great humor and interesting tales.

The FDIM 2010 QRP Challenge

This year we have added a special category to the Homebrew Contest. It is called The FDIM 2010 QRP Challenge. The objective is as follows—Design and build a QRP Transceiver using the following rules:

- The transceiver is limited to a maximum of 72 parts*.
- The receiver must be a superhet or other "single signal receiver."
- Keying and muting must be included.
- Covers at least one of the standard QRP Frequencies as listed at http://www.qrparci.org/content/view/4304/128/
- Capable of battery power for portable use.
- Power source not considered in the 72 parts count.
- Schematic with parts list and functional XCVR be brought to FDIM 2010.

* Only one part may be an IC, other parts must be discrete components. Knobs, sockets, tuning dials, copper board and enclosures are not considered parts. (Details and FAQ at qrparci.com)

Idea Exchange

Technical Tidbits for the QRPer

Mike Czuhajewsi—WA8MCQ wa8mcq@verizon.net

In this edition of the Idea Exchange:

Regarding Diode Ring Mixer Performance with LO Power

This article by Wes Hayward, W7ZOI (dated 13 December 2008) is from the Files section of the EMRFD discussion group on yahoo.com. Founded in July 2006 by Roger Hayward, KA7EXM, the forum is a "Gathering place to discuss experiments, projects, improvements, etc., and technology in the same vein as that found in the ARRL publication Experimental Methods in Radio Frequency Design." You can join from its home page at http://groups.yahoo.com/group/emrfd/ —WA8MCQ

After reading the most recent posts to the EMRFD Group, I decided that an experimenter [sic] was in order. Similar results can be found in catalogs from Mini-Circuits. I looked around the parts bin and found a SBL-1 mixer mounted in a small box with BNC connectors, so this became the basis for the experiment. This is a so-called Level 7 mixer with four hot carrier diodes and two small ferrite bead trifilar wound transformers. It is an earlier variation of the TUF-1 and other similar, more up-to-date designs. I set up a signal generator at 37 MHz as a local oscillator. A second signal generator was set to 30 MHz with a level of –30 dBm. A spectrum analyzer was attached to the IF port and set up to observe the down converted 7 MHz IF output. The analyzer was always run with at least 10 dB of attenuation to guarantee a reasonable wide band mixer termination.

Figure 1 shows the measured conversion gain for LO powers from –10 to +10 dBm. Nothing like real data to replace lore. Dropping from the nominal +7 dBm LO power to 0 dBm produced only 1.0 dB of additional loss from the measured 6.0 dB loss at +7 dBm LO. Dropping below 0 dBm produced more severe gain loss.

I did not do measurements of IIP3 with LO power, but have done so in the past. Generally, the inter-modulation distortion suffers much more than conversion gain. It is IMD performance that comes from LO power. Generally, the intercept will tend to drop as fast as the LO power, dB per dB.

The digital LO drive question is complicated. Some of the faster HC chips available these days can do bad things with casual application, yielding outputs that are not as square as the designer might have sought. I experience this with a 74AC74, seeing a divide by 2 output that was amazingly non-square. Such distortions can really trash the port to port isolation. I got better results with a 74HC74.

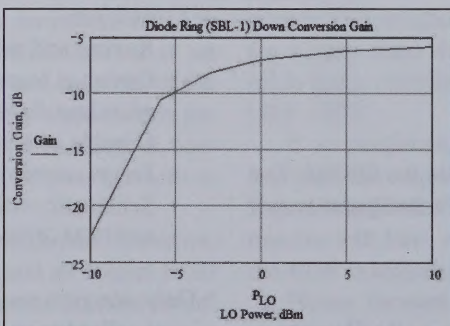


Figure 1—Measured down conversion gain of an SBL-1 mixer vs. LO power.

The point here is that blanket statements that "digital drive is better" are best replaced with careful measurement.

I examined the performance of diode rings with digital drive years ago in an earlier lifetime. My results were no more than a confirmation of the classic work on this subject, which is presented in the British literature. See the paper by H. P. Walker, "Sources of Intermodulation in Diode-Ring Mixers," *The Radio and Electronic Engineer*, 46, 5, pp. 247-255, May, 1976. Walker did not see improved performance with digital drive. Rather, what he saw was a realization of the intrinsic mixer +7 dBm LO capability with as little 0 dBm of square wave drive. Essentially, the critical performance parameter is not current, but the rate of change of current at the LO zero crossings. I don't have any of my early data available.

Diode ring mixers, as well as most mixers used for RF work, are specified in terms of available LO power. The word *available* is emphasized. If we say that the LO power is +7 dBm, what this really means is that a signal generator is attached to a power meter or spectrum analyzer and adjusted to deliver +7 dBm at the desired frequency to the 50 ohm instrument. Once the power is set, the cable is disconnected and reattached to the mixer. This is not the power that is delivered to the mixer. Rather, it is the power that is available from the generator. (There's that word again.) This is not a casual use that I've generated, but a long established formalism found within the RF design community. For example, see Terman, *Electronic and Radio Engineering*, p76, McGraw-Hill, 1955. Much of the professional RF community is pretty sloppy in the use of the term and in the specification of LO power.

—DE W7ZOI

Quickie Milli-Ohmmeter

Back in the early 90s, Joe Everhart, N2CX, offered me an endless string of Technical Quickies if I wanted them and he hasn't let up yet. Here's #72—

Magnetic loop antennas have always

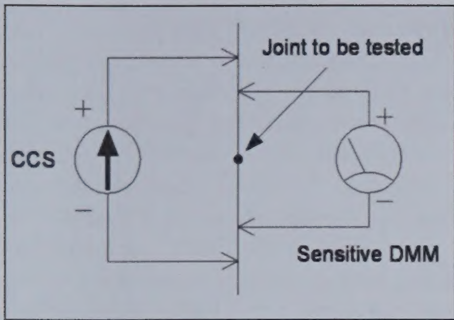


Figure 2—Low resistance measurement.

fascinated me due to their space efficient nature. Of course as we are constantly reminded, nothing comes for free in this world. Some calculations, either manual or by means of a computer program, will show that magnetic loops have a very low radiation resistance. See Reference 1 for a good discussion, and Reference 2 for a handy spreadsheet that works with both Windows Excel and Open Office under both Windows and Linux.

Magnetic loops have a radiation resistance in the range of milliohms to tens of milliohms so in order to operate efficiently loss resistance must be kept to a minimum. Loss due to the basic loop structure can be calculated in terms of skin resistance. However there are often additional losses due to electrical joints in the structure and tuning capacitors than are not amenable to calculation. Much more can be said about magnetic loop parameters and loss—an interesting topic—but that may deferred to a future Quickie.

This Quickie describes a simple means of accurately measuring these low resistances at DC. Since they are due to physical and electrical joints which generally are not frequency dependent, DC measurements also reflect the resistance at RF.

Simple digital multimeters (DMMs) are good for measuring resistances ranging from perhaps as low as one ohm to many megohms. However, the inherent resistance of test leads and joints formed by connecting them to a device to be tested prevent accuracy for resistance much less than an ohm. A simple way to overcome this problem is to break the test equipment into two pieces. A circuit called a constant current source (CCS) can be used to induce a calibrated amount of DC current into a joint being tested for resistance ranges of millionths of ohms to tens of ohms. Then a separately connected millivoltmeter can be used to measure the voltage drop across the joint. See Figure 2. Since the voltmeters resistance can be a megohm or more, the resistance of its leads and connections adds negligible loss. Resistance of the joint can be determined by dividing the measured voltage by the constant current value. For example, with a current of 100 mA and a measured voltage of 1.5 mV the resistance is 15 milliohms.

As it turns out, 100 mA is an easy current to generate accurately using a simple CCS without resorting to expensive or complicated circuitry and is low enough to prevent damage in high resistance joints that might result with larger currents. Also, good quality four-digit DMMs are available for under $100 that will resolve voltages down to tenths of millivolts with acceptable accuracy.

Figure 3 shows the schematic diagram for a good CCS. It uses an LM317 voltage regulator, a six volt battery power source (4 AA cells), some inexpensive half watt resistors and a low resistance potentiometer. The voltage regulator IC has an internal voltage reference of about 1.25 volts. When connected as shown it maintains a current output that precisely sets the voltage drop across the resistive network to exactly 1.25V. When the potentiometer is set so that the total network resistance is 12.5 ohm the current through it is 100 mA. This current is maintained no matter what external resistance is connected across the circuit output as long as the voltage drop across the external resistance is less than about one volt, corresponding to about 10 ohms. Since current is drawn from the power source only when an external resistance is connected, no on/off switch is needed.

Figure 4 is a photo of the finished CCS and Figure 5 shows the inside of the box. A convenient plastic box with a metal lid was employed, sized so that all of the components would fit. A four-cell AA holder connects the alkaline batteries to a piece of

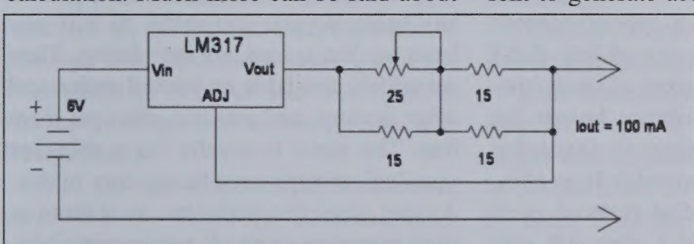


Figure 3—100 mA Constant Current Source (CCS).

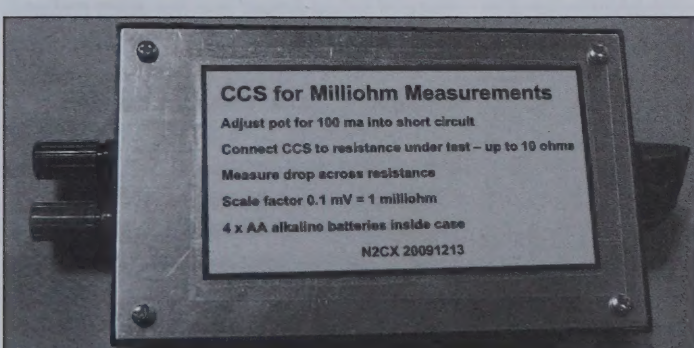


Figure 4—The finished CCS.

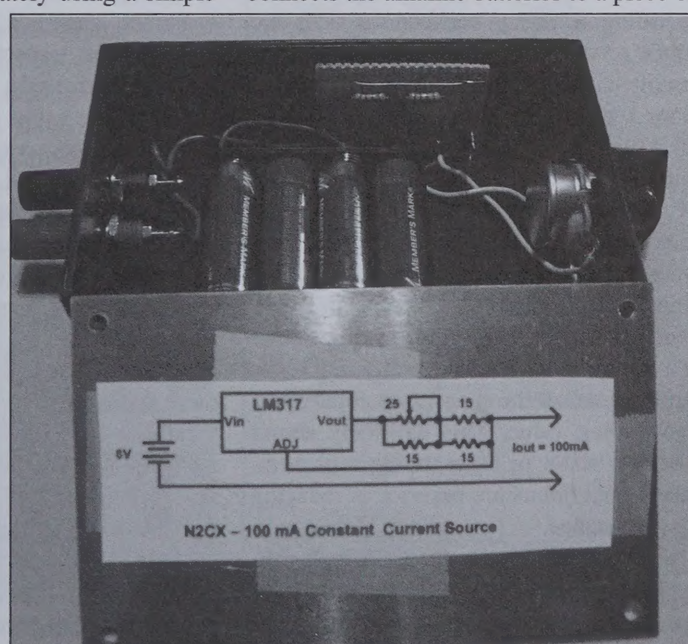


Figure 5—Inside the CCS.

perforated board containing the active circuitry, the potentiometer is mounted on one end wall and two five-way binding posts are on the other. The battery holder and perforated board are held in place using some of the ubiquitous double sided foam tape. For future reference, a copy of the circuit diagram is glued to the inside of the metal box cover. You may also note that operating instructions are taped to the outside of the metal cover both for ease of identification and to provide a memory jogger when I forget how to use the gadget six months down the road.

Using the milliohmmeter setup is quite simple. First the DMM is set to measure DC current on a 200 ma range and connected across the + and – CCS terminals. Next the potentiometer is set to produce exactly 100 mA. The CCS is now calibrated. The CCS is disconnected from the DMM and connected across the junction or contacts to be measured using alligator clip leads or appropriate other connection means. The DMM is now set to read mV on an appropriate range such as 200 mV full scale and connected across the junction or contact under test between the CCS connection and the joint. This needs to be done directly to the conductors and not to the leads from the CCS so that resistance in the CCS connections is not in-circuit. Now the DC voltage is read from the DMM. As mentioned earlier each 0.1 mV corresponds to a resistance of 1 milliohm.

These measurements can be quite revealing. Readings between the shaft and frame on a half dozen variable capacitors readily available in the junk box ranged from 1 to 100 milliohms, typically about 20 milliohms. If this typical one was used with a loop with a radiation resistance of 20 milliohms, efficiency could be no better than 50% even with no skin effect loss from the loop conductor. Not only is there significant resistive loss in capacitor connections but since the rotor to frame joint is a friction joint, it shows a different resistance whenever the capacitor is rotated to a new tuning value. This definitely shows that split stator or other tuning caps without moving joints are superior in reducing loss resistance.

Yet another use for the CCS is in calibrating shunts for milliammeters. As designed, the CCS supplies 100 mA although by changing values in the resistor network other currents can be obtained.

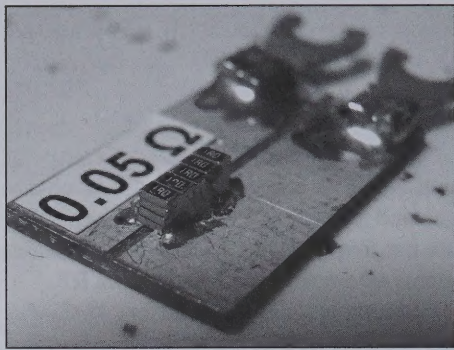


Figure 6—Fifty milliohm (0.050 ohm) resistance board with 20 one ohm resistors in parallel. An ordinary DMM cannot detect if one of them is open.

For further reference on CCS designs for other uses, check out References 3, 4 and 5 on the Web.

References

1. www.aa5tb.com/loop.html
2. www.aa5tb.com/aa5tb_loop_v1.22a.xls
3. www.edn.com/article/CA408390.html
4. www.nutsvolts.com/index.php?/blog/post/build_an_audible_milliohmmeter/
5. www.rcgroups.com/forums/showthread.php?t=580151

—DE N2CX

WA8MCQ comments—The very low resistance measuring technique Joe describes is sometimes known as 4 wire or Kelvin testing. A couple of years ago I made a specialized version of the device he describes, designed as a special purpose fixture to test a specific type of item that I made. I fabricated a number of small, specialized low value resistance boards for some Q meter experiments involving series resistance. All were made from identical pieces of copper clad material, with various combinations of 1 ohm, 1% surface mount resistors (size 0805) soldered to them. (Song Kang, WA6AYQ, kindly gave me a batch of them which gave me a good start, and I later picked up a reel with more on eBay.) Nine of the small boards were less than one ohm and I needed to measure them accurately to insure that none of the resistors were damaged during the soldering process. This would have been impossible with an ordinary DMM.

The worst case was the 0.05 ohm board, shown in Figure 6. It consists of 20 resistors in parallel, arranged in 4 layers of 5 resistors each. That involved a fair amount of soldering—they were carefully soldered in place one at a time, although it was much easier to do than expected. (The stereo zoom microscope helped tremendously!) The net resistance should be 0.050 ohms. If even a single resistor was damaged during installation, it would have been 0.0526 ohms. Quite impossible to detect with an ordinary DMM, the 2.6 milliohm difference is easily visible when using the 4 wire method. (Since my device also uses a current of 100 mA like Joe's and my DMM only reads out to a tenth of a millivolt, I'd lose that final digit and only be able to detect changes of 1 milliohm, which is still more than sufficient in my case.)

I started writing up my milliohm measurement article over 2 years ago. Now that Joe has brought up the subject, I'll have to finish it off and run it some time this year.

—DE WA8MCQ

Tubing Assortment from a Whip Antenna

I ran into W3TS, Mike Michael, at the last area hamfest of the season and while we were talking he passed this tip along. He asked me if I knew where you could get a free, small piece of metal tubing, and then pointed to the whip antenna on a shortwave radio he was selling. All you have to do is chop off one end and push all the segments out; it's a readymade assortment of various sizes. The material is usually brass, so you can solder to it if you have to; just scrape off the plating. They are widely available on junked radios and other devices, and you can often get them free. The metal is usually fairly thin, but you don't always need heavy duty tubing. Among other things, he has used them as shaft extenders on small tuning capacitors. Secure one end to the shaft, then jam a piece of wood dowel into the other end and put a knob on it.

Equipment Bails from Old Handles

It's handy to have a bail (tilt stand) or pair of long feet on the front of a radio to lift it up from the operating surface. These are usually of the flip-down type, but that feature isn't always necessary; something in a fixed position is just as useful. This idea of using old equipment handles (Figure 7) was e-mailed recently from Maurice Mezzera, KG6MFT.

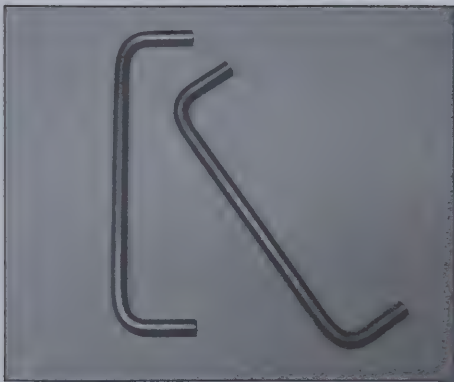


Figure 7—Equipment handles to be repurposed as equipment bails.

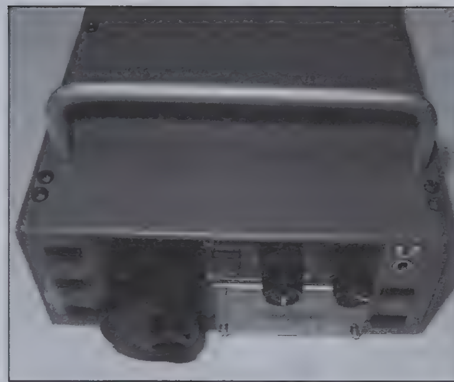


Figure 8—Drill a pair of holes and mount the handle on the bottom.

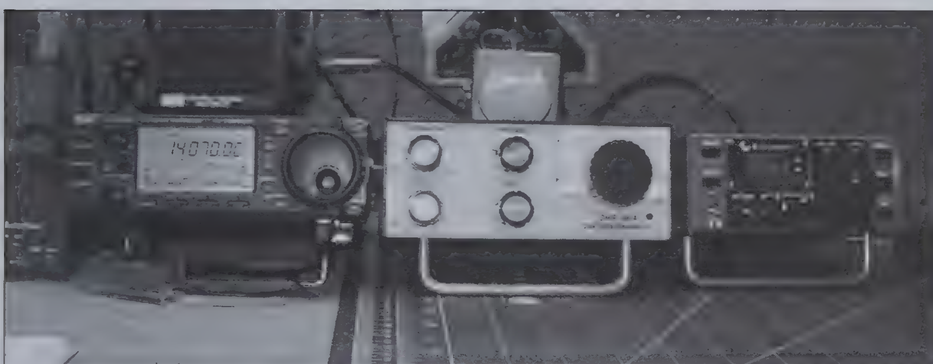


Figure 9—Radios with added bails.

He got these from old instruments found in his favorite junk yard, Apex Electronics. If you can't find some of a suitable size locally you can find them online at various surplus places, such as www.apexelectronic.com. (Caution—The name has an "s" but the URL does not. If you type it as "apex electronics" you'll get a completely different site which deals with audio things such as microphones and headphones.)

You can also find handles at distributors such as DigiKey, Mouser, etc., although new ones tend to be rather expensive. Mounting is simple, requiring just a pair of holes and screws (Figure 8). Figure 9 shows some of his radios, one with a built in bail and two that he added.

—WA8MCQ

Super Tunable Trap Test Accessory

In working with wide band amplifiers in recent weeks I found the tunable trap idea of figure 7.57 in EMRFD to be very helpful. Specifically, in watching the amplifier performance on my spectrum analyzer I was often not sure if harmonics that appeared were due their presence in my test signal source (an old Wavetek sweeper) or if the amplifier under test was distorting. But I needed to cover from a few MHz to over 100 MHz more conveniently, so the Super Tunable Trap came into being.

The STT is pictured in Figure 10 and shown schematically in Figure 11.

This wide-ranging tunable trap is very easy to use with its three overlapping ranges and in general can produce a 20 to 30 dB notch in a 50 ohm system. As should be clear from the schematic, one 2P3T slide switch selects one of 3 inductors and the other 2P3T switch selects one or the other variable capacitor section, or both sections in parallel. Generally, I can find the same tunable frequency with more than one switch combination with one of the choices yielding the deepest notch.

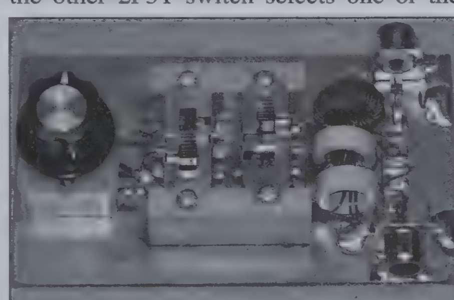


Figure 10—The Super Tunable Trap. As built, it covers approximately 4 to 110 MHz.

In operation, the STT is inserted in the test signal line from the generator to the amplifier under test. It is then tuned to the harmonic-of-interest in an attempt to eliminate it in the signal source path. For an amplifier operating quite linearly the selected harmonic is typically eliminated. For an amplifier that is distorting, the selected harmonic is typically reduced. This is because part of the total output is due to source content and part is often the amplifier's contribution. In any case, since I'm pursuing a myriad of amplifier designs, I found this versatile, not-too-difficult assembly to be well worth the effort to build it—and in this case I had all the parts in the junk box (a rare occurrence!).

WA8MCQ comment—When swapping mails with Bob about this, I asked him if he had made up a chart or cheat sheet of switch settings versus frequency ranges; this was his reply—

No. I gave up on that when I first tried it, so now I just fumble my way through the several tuning/switch combinations. It's actually pretty easy to do. Part of the diffi-

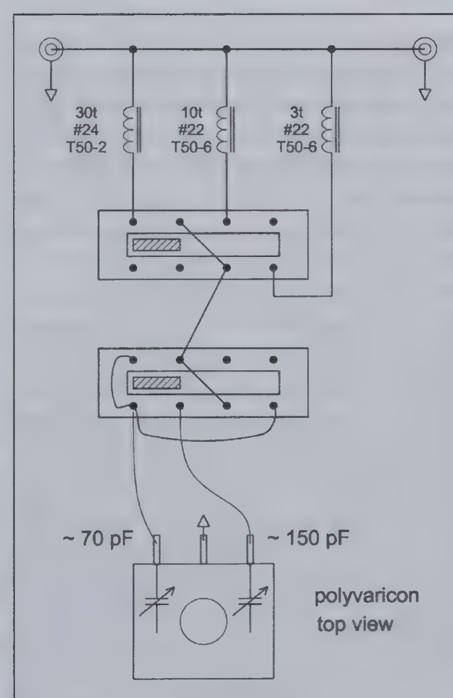


Figure 11—Schematic of the Super Tunable Trap. The DP3T slide switches used in the circuit are Mouser part no. 629-G128S3011.

culty with an operational matrix is that there are both overlap and somewhat indistinct effects of the two lowest range combos of the polyvaricon switching, i.e., not much difference between 150 and 220 pF, but I wanted to "use up" all the flexibility I could wring out of what was available anyway.

—DE K3NHI

Unprotected Batteries in Your Pocket

Posted by GØXAR to the GQRP forum on yahoo.com, here's a simple safety tip that may seem a bit obvious but which could happen to any of us since we can all do unsafe things without thinking about it. The subject line of this was "OT Never put a PP3 battery and a pound coin in the same pocket..."

So there I was, drinking coffee on the YLs sofa and Paddy the spaniel made a lunge for the mug. Then I felt this warm sensation against my leg. Signs of spilt coffee there were none, so I put my hand inside the pocket and discovered that said PP3 battery was in contact with a pound coin and was discharging itself. I managed to extract both of them before I burnt myself. However the PP3, a rechargeable from Maplins, expired. Putting a PP3 in my pocket was a really stupid thing to do. Please learn from my mistake.

—DE GØXAR

WA8MCQ note—The PP3 is what those of us on this side of the pond more commonly refer to as a 9 volt battery. It has a pair of unprotected metal terminals sticking out of one end, side by side, and they can easily be shorted together by anything metallic. That includes coins, keys, a key ring, etc. And a lot of other batteries are almost as bad. I looked at the ones in my cell phone and ancient Nikon digital camera. The contacts on both are only slightly recessed below the surface and could be shorted almost as easily.

And pockets and batteries with closely spaced contacts aren't the only possibility. It could even happen with something like AA (penlight) cells, which have contacts on opposite ends from each other. At work I have a couple of them on my desk in a small dish, spares for a digital camera. I also have a coworker who aggressively collects pop-top tabs from soda cans for charity. Every time he came into my office he'd dig in the waste basket, collect the cans, snap off the tabs and make me feel

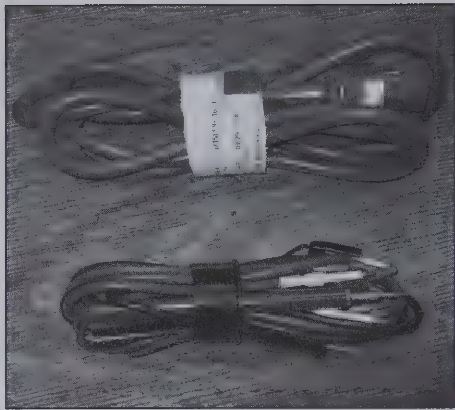


Figure 12—Additional uses for small plastic bottles, keeping leads and cords secured.

guilty. I finally started doing it myself and have a pile of them whenever he comes around. Three guesses where I'd store them—yup, they went straight into the dish with the AA cells without thinking of the possible consequences. Fortunately nothing happened, although the pile was almost covering the cells since he hadn't been around for several days. That's plenty of small pieces of metal, more than enough to contact both ends of an AA cell and potentially provide a current path. Luckily they were loose and there was not enough pressure on them to force good contact, but the potential was there.

Those who operate QRP portable with spare batteries are even more vulnerable to this sort of thing happening, and I've read a couple of posts over the years of something in a backpack accidentally shorting out a battery. Be sure to keep all terminals covered.

—DE WA8MCQ

More on Old 35mm Film Canisters

In the last issue I ran an item by K3NHI, who uses these increasingly rare items to hold small bits of wire, by cutting slots in them to hold the ends. He recently sent along this additional application for them, as well as empty prescription medicine bottles, shown in Figure 12. (Although the film canisters are disappearing rapidly as digital photography is replacing film more and more, it's probably a safe bet that medicine bottles will be around for years to come.)

I also received e-mail from legendary GQRP member George Burt, GM3OXX—

I enjoyed the wee article by K3NHI

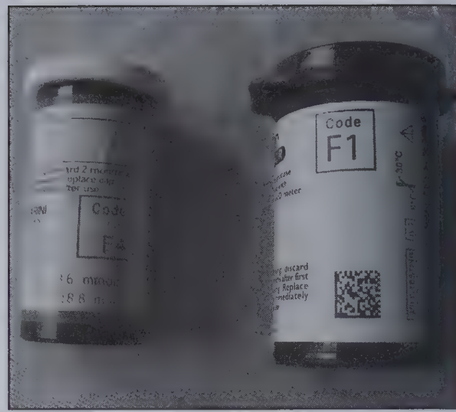


Figure 13—Diabetes sensor canisters are handy replacements for the disappearing 35 mm film canisters.

and laughed about the remarks that the 35 mm film cans will be disappearing with time. But not all is lost; diabetics to the rescue! All you need to do is find a friend that is a diabetic, which should be as easy in the USA as it is over here. I throw lots of the smaller sensor canisters away every month, thinking they would make nice coil formers for simple rigs. Figure 13 shows both types of canisters, for 25 and 50 sensors, which should be perfect replacements for the old film ones.

—GM3OXX

Holding Parts for Soldering

Charles Moizeau, W2SH, posted this to the QRP-L online forum, received favorable feedback and decided to pass it along for the column—

Always on my workbench when doing any soldering of electronic equipment, SMT, through-hole, Manhattan-style, boat-anchor point-to-point, etc., is a roll of two-inch wide blue masking tape manufactured by 3-M, along with a good pair of sharp scissors.

For any component I wish to hold in place, I cut transversely from the roll a two-inch long strip of whatever width is appropriate to the task at hand. I use this tape strip to strap the component to the board or chassis in its correct position before I come bumping up with any tool, solder, flux or whatever else might accidentally disturb the components position. When so strapped down, I can lift the board or chassis in my two hands, rotate it, tilt it, carry it across the room to a different light, even transport it to the john when nature calls, or do whatever else suits my

visual examination or other needs, confident that the component will remain properly placed when I decide to solder.

For SMT work, center a thin two-inch strip of this tape on top of the SMT component. Lift the tape at each end with both hands. Carry this assembly to the desired location, position it accurately and strap the component down to whatever surfaces are adjacent.

If you're timid, tack solder one terminal, check positioning and make any adjustment (none should be needed if the component has been firmly strapped into the proper location), and then proceed to final soldering.

This blue tape works very well for me. It leaves no residue as other tapes often do, and it is decidedly less pesky than using beeswax, Blu-tak or other gunks, doofus weight jigs, toothpicks, and goodness knows what else.

—DE W2SH

HP8640B as Limited Range Sweep Oscillator

Every now and then someone writes an article about building and aligning crystal or LC filters by using a small sweep oscillator, a sawtooth generator to control it, a detector and an oscilloscope. The sweeper is usually just a simple voltage tuned oscillator, although things can get complicated if you want to cover multiple bands. But if you have an HP8640B signal generator (or the big yellow military equivalent, USM-323) you can use that for the sweep oscillator instead.

A while back on the HP/Agilent equipment discussion forum on yahoo.com someone asked if he could use the 8640B as a tracking generator with a particular spectrum analyzer. Someone said no, and pointed out that most tracking generators are voltage tuned but that the 8640B uses a mechanically tuned cavity oscillator. Jack Smith, K8ZOA followed with this post:

"The 8640B can be used as a tracking generator for some specialized applications, such as sweeping a crystal filter that is a few kHz wide, where stability and low phase noise are necessary and a wide frequency sweep is not required. Use the 8640B in FM mode, DC coupled.

"Before I had better test equipment, I've had success with this approach. It requires some fiddling with voltage levels and the like, but it will work. The main

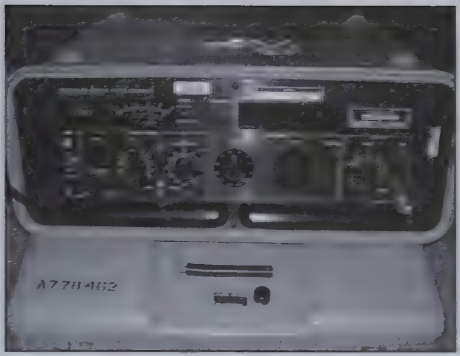


Figure 14—The USM-323, military version of the HP8640B signal generator.

limitation is the available FM deviation, of course."

I have the USM-323 version but was too lazy to haul it out, set it up and try it, so I was going to present this as an untried idea that sounds like it should work. But then I checked the manual for the 8640B and found that not only will it work nicely as a limited range sweep oscillator, they actually mention it.

From paragraph 1-42: "FM is calibrated, metered and constant with frequency and band changes. Peak deviations to at least 0.5% of carrier frequency are available (i.e., 1% of the minimum frequency in each octave band). On the 256-512 MHz band, for example, the maximum deviation is 2.56 MHz peak or 5.12 MHz peak-to-peak. With this wide deviation capability, it is possible to sweep the generator, using the DC coupled FM mode and a sawtooth input, to test and align IF filters and discriminators."

Translating that into the ranges we'd be most likely to use it on, on the 2-4 MHz range a maximum sweep of 20 kHz in one direction from the carrier frequency is possible (1% of the low end of the range or 0.02 MHz), or 40 kHz total, going both above and below the center. On the 4-8 MHz range a total sweep of 80 kHz can be achieved, and 160 kHz on the 8-16 MHz range.

The 8640 is rather long in the tooth nowadays, it has drift issues unless you turn on the frequency lock switch (which is not even available on the military version), and it has a mechanically tuned oscillator. You have to do a lot of cranking to change frequencies; no keypad for quick entry and no remote control is possible. However, it has long been prized for its low phase noise on the output. Indeed, somewhere on his web page K8ZOA refers to it as the gold standard for low phase noise generators. In recent years prices of them have dropped significantly on the surplus market. (You can find them on eBay all the time.)

Figure 14 shows the USM-323 version, which I have, also known as model 8640B OPT 323. It does lack some features of the commercial version such as the frequency lock mode (which is basically a Huff 'n Puff circuit, if anyone remembers those), and it also does not allow using the frequency display counter to display external signals, but I've never found those to be significant problems. (Whenever I saw photos of the military version I wondered about the two large horizontal "things" at the bottom of the front panel. After I finally bought one I discovered that they are air inlets and outlets. The unit is completely sealed in the large steel case, and there is no other ventilation. This is not applicable to the commercial version, of course.)

Being so old there are problems that appear sometimes, with the most common being contacts falling off plastic switch rotors, nylon gears cracking and the output amplifier failing, but those are well documented and fixes are available. I once saw a recommendation that they not be stored vertically for long periods of time, since it is said that the grease lubricating the mechanically tuned cavity can flow away from certain places and cause intermittent operation. When I read that I hauled mine out of storage where it had been for many months, sitting vertically, and sure enough the tuning was erratic at first. It did clear up after some use.

K8ZOA, who operates Clifton Laboratories, has a very interesting web page which is well worth a look. I hadn't visited it for a couple of years, and the home page seems to be more product oriented than I remember; you have to dig a little bit now to get to the articles but it's well worth the effort. The URL is http://www.cliftonlaboratories.com/ and then click on Adventures in Electronics and Radio.

—DE WA8MCQ

Using High Value SMT Resistors as Standoffs

Construction techniques are sometimes discussed on QRP-L (the one at qth.net), and recently someone mentioned use of

high value resistors (a megohm or more) as tie points when doing so-called "ugly construction," also known as dead-bug style.

Someone suggested that physically large, high value SMT resistors (such as 1206 size) would be a smaller and sometimes better looking option. As with leaded resistors, they would be mounted vertically with one end soldered to the substrate and the other end used to terminate component leads. Here is the reply I posted:

The short answer to that suggestion is "Not recommended." Although it sounds like a good idea it doesn't necessarily work out in practice. Anyone who has actually tried this with SMT parts will tell you that it's an invitation for trouble sooner or later. Roy Lewallen, W7EL, warned me about this when I was at Dayton in 1997 or 1998, and even back then he was preaching to the choir; I'd already heard the same thing from several people.

I've never tried it myself (since I know what will happen), but I certainly believe it; it's intuitively obvious when you think about it. Keep in mind what you're working with—very small, thin, fragile parts that cannot withstand much stress.

Although this might work in the short term, sooner or later something is going to bump something else, putting stress on a vertically mounted SMT part and snap it. It might break apart in the middle, perhaps the main body will break away from the end metal termination, or the entire component might simply pull out of the solder joint. If it was a high value resistor used as a standoff the effect on the circuit will be nil, and support of the other component leads may well keep the junction suspended above the board, at least for a time. On the other hand, if it was a much smaller value component which is also part of the circuit—such as a base bias or emitter resistor—you now have an open circuit and a more immediate problem.

(When building circuit boards commercially, SMT parts will sometimes come out of the reflow oven standing straight up in the air in this manner and must be reworked to make them flat. The term for this defect is tombstoning.)

—DE WA8MCQ

External Leakage Field of Toroid and Solenoid Inductors

Measuring mutual coupling between toroidal inductors is an interesting experiment that I have been thinking about doing for a good while (which means that it will probably never get done) but K8ZOA, Jack Smith, actually did it. He also put much more effort into it than I would have. W7ZOI sometimes makes comments about "lore" and says we need to do experiments and have numbers to back it up (or disprove it). Here's some lore and some numbers to go with it, from the K8ZOA web site.

—WA8MCQ

One bit of amateur radio lore is "a toroid inductor is self-shielding" and hence does not have an external field to interact with other inductors or with nearby conducting objects such as the enclosures.

Like many fables, there's some truth in this statement, but it's far from being 100% correct. In building a prototype notch filter recently, I ran across a case where there was not enough room to space toroid inductors to minimize unwanted coupling and hence found shields between adjacent inductors necessary. This led me to make some simple measurements to demonstrate the difference between the external fields of a toroid and solenoid inductor.

The data I collected is not the most sophisticated, but it shows the concept. The solenoid core at the left in Figure 15 is 36 turns on a 0.5 inch diameter Delrin core, and measures approximately 7 uH. The toroid core at the right is 25 turns on an T50-7 core, and measures 2.8 uH. The long object in the center is the test coupling probe I use with a spectrum analyzer as a "signal sniffer." It consists of a 5 turn shielded pickup loop constructed from coaxial cable, with a BNC connector at the other end of the probe handle. The two large black cores are high μ ferrite cores that reduce coupling from the outer shield to the sensing coil.

I connected the inductor under test to the output port on an HP 8752B vector network analyzer and the signal sniffer coil to the VNA's receiver port, with the VNA in transmission mode. Since these inductors are of a value and construction that would typically be used in the MF and HF range, I set the frequency range to cover 300 kHz to 30 MHz, with log sweep.

I made two pairs of measurements by positioning the sniffer coil to be coaxial with the solenoid and with the toroid core, at approximately 1 inch and at 3 inches spacing. I also made a third pair of measurements orienting the sniffer coil to achieve maximum coupling at 10 MHz.

The VNA data (Figures 16 and 17) shows the loss in dB versus frequency between the sniffer coil and the inductor under test. This loss provides a quick and

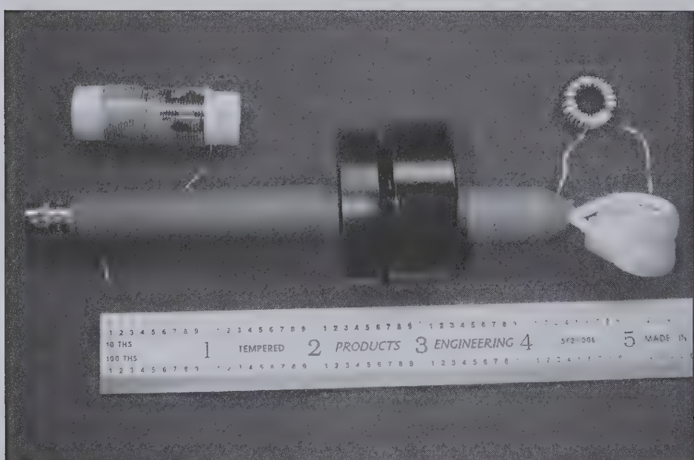


Figure 15—Test coupling probe and the two inductors to be tested.

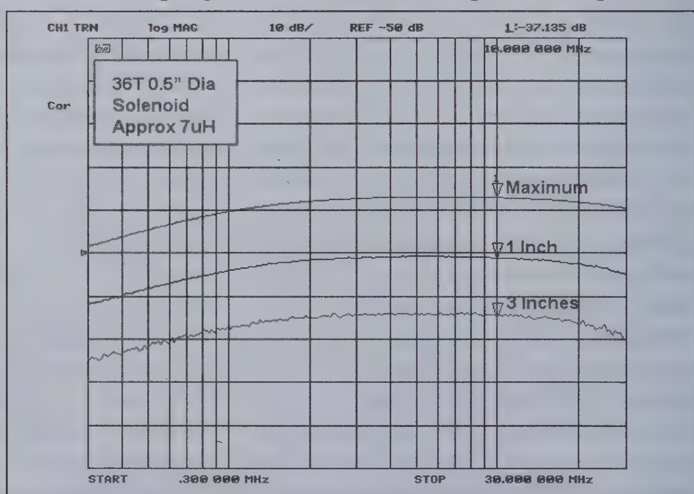


Figure 16—Coupling to the solenoid at various distances.

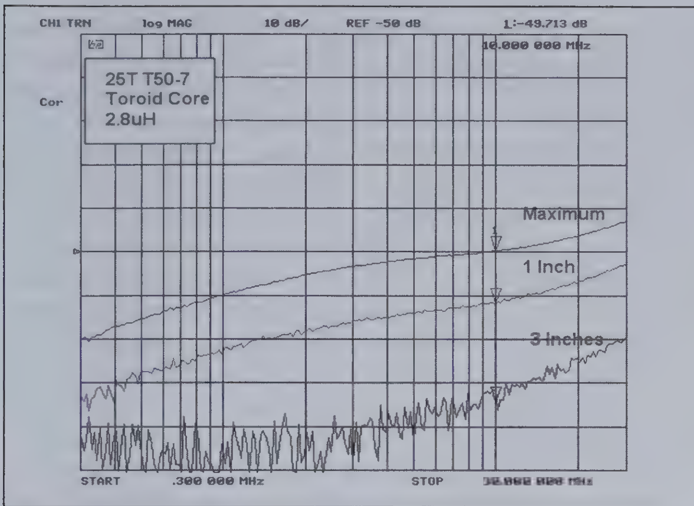


Figure 17—Coupling to the toroid at various distances.

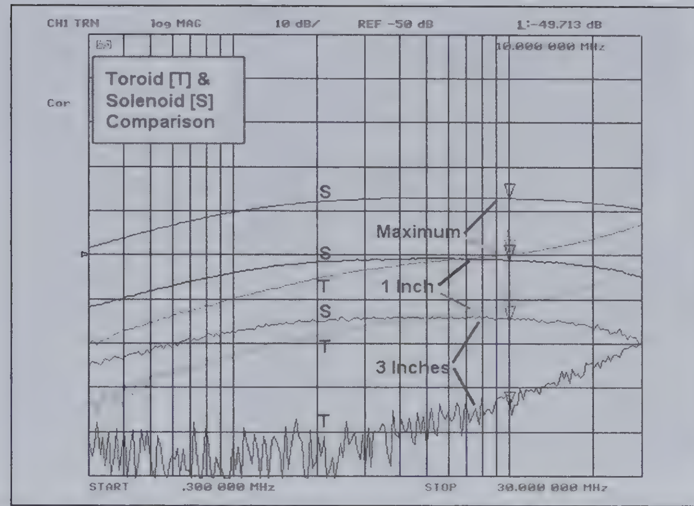


Figure 18—Side by side data for comparison.

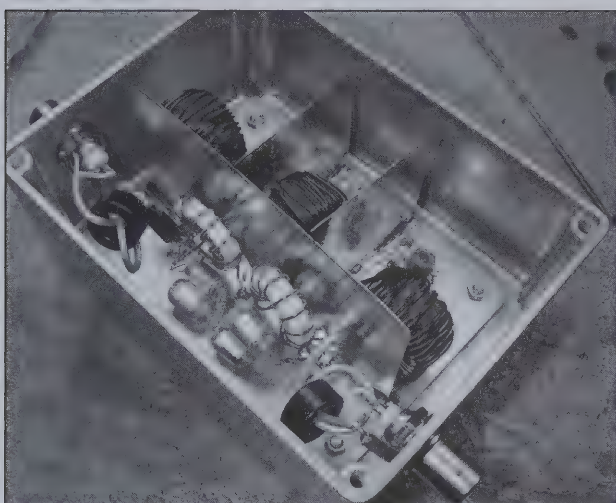


Figure 19—An experimental filter using toroids with shields for better performance.

dirty approximation of the external field of the two inductors and hence their propensity to couple to other inductors or the environment. If the toroid is truly self-shielding, there will be no signal pickup.

The solenoid inductor shows a worst case coupling of 37 dB at 10 MHz and even with 3 inch spacing has about 63 dB loss. (Figure 16.)

As shown in Figure 17, the toroid inductor—while some 10-20 dB better than the solenoid—has a far from zero external field.

The rather cluttered plot of Figure 18 shows all six test runs. The data shows that at lower frequencies and greater spacing the toroid has perhaps 20 to 25 dB less external field than the solenoid inductor. However, at higher frequencies and closer spacing, the external fields begin to converge.

In terms of the filter I'm working on, the photo in Figure 19 shows the experimental layout with shields added. The shielding material is thin tin-plate stock obtained at the local hobby shop. It's easy soldering material and can be cut with tin snips or even heavy duty scissors. Although I oriented the three large inductors to minimize coupling, given the size of the parts and the available space, there's only so much that can be done to reduce unwanted coupling by orientation and core-to-core spacing.

Whether or not the external field of an inductor is a problem depends, of course, on the application. In many circuits, coupling between inductors down 50 or 60 dB is inconsequential. However, if you are working with a filter and wish to achieve 100 dB band stop rejection, great care must be taken to avoid unwanted coupling. In the case of the Z10020 band reject filter [a Clifton Laboratories product], careful printed circuit board layout allows very high stop band rejection to be achieved without shielding. In the case of the experimental filter of Figure 19, shielding is helpful in achieving target performance goals.

[While exchanging e-mails with Jack about his article, he mentioned that he had an additional experiment he wanted to do eventually and offered to do it immediately since I was up against the deadline. He posted the following updates to his web page. It's very similar to some experiments I did a couple of years ago but haven't written up yet, and results are similar to mine. —*WA8MCQ*]

Single Turn Effect

Dr. Rudolf Rieder commented on my data:

"When fighting against pick-up from a switching DC-DC converter I ran into a note (forgot the reference) pointing out that although the toroid core does pretty well include the magnetic field of the coil wound around it, the coil itself forms a net 1-turn loop around the circumference of the torus. If you want a (more) "quiet" switching power supply you ought to bring the ends of the coils together by forming an external 1-turn backward-loop (or 2 1/2-turn loops), thus compensating the field (effectively a "bifilar" design). At the time this small change helped a lot.

"I am therefore wondering whether a similar approach to RF-toroids wouldn't have a similarly beneficial effect, i.e. a significant reduction of stray fields and thus coupling. If you feel like it next time, please try it and repeat the measurements. I'd be quite curious to read about it when next visiting your page."

This is correct. The typical toroid inductor can be considered to be two inductors. One is the traditional "circular solenoid" where the magnetic flux follows the core and the second is the one-turn

Figure 20—Toroid mounted on aluminum sheet with nylon hardware.

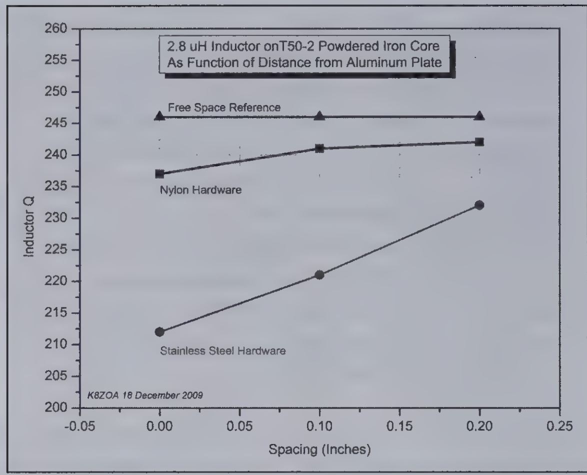


Figure 21—Effect of spacing and hardware material on inductor Q.

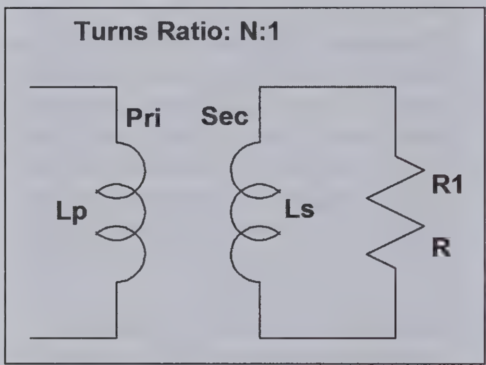


Figure 22—Metallic hardware becomes a shorted turn, effectively adding a shorted secondary winding.

Figure 23—An experiment with shorted-turn mounting, resulting in both reduced Q and a lower inductance value.

loop mentioned by Dr. Rieder. Thus, even if 100% of the flux of the "circular solenoid" is confined to the magnet core, the one-turn loop is certainly not so confined.

I'll look at the one-turn effect in more detail in the future.

Effect of Nearby Shielding on Q

One consequence of flux leakage is that the inductor loss—and hence Q—is influenced by nearby metallic objects. The leakage flux induces current in nearby conductors and since the energy lost in the conductors is provided by the inductor, the inductor's total loss increases. Q is inversely proportional to loss, so increased loss translates to lower Q.

This effect can be visualized in several ways. Perhaps the simplest is to think of it as a transformer, with the inductor as the primary and nearby conductors as multiple secondary windings. The secondary windings have resistance and hence loss. The induced current and hence the level of loss depends, in transformer terms, upon the coupling coefficient, which relates primary flux and secondary flux. In a good transformer, primary and secondary flux is tightly coupled, with a coupling coefficient very near 1.00. In the case of a toroid inductor's field inducing currents into a nearby conductor such as a shield, the coupling coefficient will be nearly, but not quite, zero.

A common example of induced field loss is seen when a toroid is near a shield. This may be an intentional shield to reduce inter-stage coupling, or it may be an inadvertent shield such as an aluminum enclosure wall. Or, the toroid may be mounted horizontally on a printed circuit board with a ground plane.

In order to demonstrate the effect of shielding on inductor Q, I made a simple test using a small piece of thin aluminum and a 2.8 uH inductor wound on a T50-2 powdered iron core, as in the earlier leakage test. The aluminum sheet is approximately 2" (50 mm) × 4" (100 mm) and is 0.050" (1.25 mm) thick.

The toroid is held in place with an axial screw, and spaced from the aluminum sheet with nylon washers, 0.1" (2.5 mm) thick (Figure 20). I made measurements with the inductor touching the shield, with 0.1" and 0.2 (5 mm) spacing, with a plastic (nylon) axial screw and a stainless steel screw. Finally, I made measurements with an intentionally poor mounting method, one that forms a shorted turn.

I measured Q and inductance with an HP 4342A Q-meter at 7.9 MHz. The "free space reference" is the measured Q without the aluminum plate.

The plot (Figure 21) shows a rather small change in Q when nylon mounting hardware is used. Indeed, even with the core touching the aluminum plate, the measured Q dropped by 10 points, from 246 to 236. A small gap of 0.1" (2.5 mm) reduces the Q by 5 points and increasing the gap to 0.2" (5 mm) reduces Q by 4 points.

In contrast, using a stainless steel mounting screw results in a much greater Q loss. The screw did not form a shorted turn; rather it was just a single vertical element with a stainless steel washer on the top. [The degradation is due to the presence of the additional metal, and its influence on the magnetic field. —*editor*]

Shorted Turn Mounting

It's common knowledge—and if it's not, it should be—that a toroid should not be mounted with conducting hardware that forms a "shorted turn," i.e., a continuous conductor making a loop through the toroid hole. The reason is that this configuration makes a rather efficient transformer and couples energy from the induc-

tor into the unintentional one-turn shorted secondary winding formed by the mounting hardware (Figure 22).

To demonstrate this effect, I made a quick shorted turn mounting, illustrated in Figure 23. This is perhaps not a very good mount, but the better the mount, the greater the loss and the lower the Q. A pair of aluminum stand-offs, for example, one through the core and one adjacent to the core edge, with a thick aluminum bar joining the two will have a greater Q reducing effect than the long mounting strap I used.

The shorted turn mount reduced the measured Q from a free space value of 246 to 152. It also reduced the measured inductance from 2.8 uH to 1.69 uH. The reason for the inductance reduction is that the secondary inductance appears in parallel with the primary (the 2.8 uH free space measured inductance).

I expected the inductance to be considerably lower than 1.69 uH and the resulting Q to be worse than the 40% reduction.

Mounting Conclusions

With small cores such as the T50 series, only minimal loss of Q results so long as the core is at least 0.1 inch from the nearest conducting surface, where non-conducting hardware is used. Conducting hardware should not be used under normal circumstances and if conducting hardware is used, it should not be allowed to form a shorted turn.

[*WA8MCQ comments*: You can view the online article on his web site at

http://www.cliftonlaboratories.com/toroid_and_solenoid_external_field.htm

And while you're there, go to the home page, click on Adventures in Electronics and Radio, then browse through that area. There's a lot of good info.]

—*DE K8ZOA*

The Fine Print

As always, if you have anything you'd like to share, get it to me any way you can, in any form. It can be on paper, 3 1/2" floppy (sorry, no 5 1/4" or 8" disks accepted!), CD, e-mail, or it could even be a quick note saying that you saw something on a web site—maybe even your own—you'd like to share with the readers. (Things on the web often disappear for various reasons, but the paper copies of the *Quarterly* will be around for some time.) And don't worry if it's not polished or if you just have hand drawn schematics. Our skilled staff (me) takes care of all of that automatically. All you need to worry about is getting it to Severn.

●●

Send your clever homebrewing ideas to WA8MCQ. It's also OK to send them to the Editor, or any of the Associate Editors listed on page 3.

Return Loss – to – VSWR Chart (1.01 to 3.50 VSWR)

RL	VSWR	RL	VSWR	RL	VSWR	RL	VSWR	RL	VSWR
46.064	1.01	18.493	1.27	13.577	1.53	10.960	1.79	8.299	2.25
40.086	1.02	18.216	1.28	13,449	1.54	10.881	1.80	8.091	2.30
36.607	1.03	17.949	1.29	13.324	1.55	10.804	1.81	7.894	2.35
34.151	1.04	17.690	1.30	13.201	1.56	10.729	1.82	7.707	2.40
32.256	1.05	17.445	1.31	13.081	1.57	10.654	1.83	7.529	2.45
30.714	1.06	17.207	1.32	12.964	1.58	10.581	1.84	7.360	2.50
29.417	1.07	16.977	1.33	12.849	1.59	10.509	1.85	7.198	2.55
28.299	1.08	16.755	1.34	12.736	1.60	10.437	1.86	7.044	2.60
27.318	1.09	16.540	1.35	12.625	1.61	10.367	1.87	6.896	2.65
26.444	1.10	16.332	1.36	12.518	1.62	10.298	1.88	6.755	2.70
25.658	1.11	16.131	1.37	12.412	1.63	10.230	1.89	6.620	2.75
24.943	1.12	15.936	1.38	12.308	1.64	10.163	1.90	6.490	2.80
24.289	1.13	15.747	1.39	12.207	1.65	10.097	1.91	6.366	2.85
23.686	1.14	15.563	1.40	12.107	1.66	10.032	1.92	6.246	2.90
23.127	1.15	15.385	1.41	12.009	1.67	9.968	1.93	6.131	2.95
22.607	1.16	15.211	1.42	11.913	1.68	9.904	1.94	6.021	3.00
22.120	1.17	15.043	1.43	11.818	1.69	9.842	1.95	5.914	3.05
21.664	1.18	14.879	1.44	11.725	1.70	9.780	1.96	5.811	3.10
21.234	1.19	14.719	1.45	11.634	1.71	9.720	1.97	5.712	3.15
20.828	1.20	14.564	1.46	11.545	1.72	9.660	1.98	5.617	3.20
20.443	1.21	14.412	1.47	11.457	1.73	9.601	1.99	5.524	3.25
20.079	1.22	14.264	1.48	11.370	1.74	9.542	2.00	5.435	3.30
19.732	1.23	14.120	1.49	11.285	1.75	9.262	2.05	5.348	3.35
19.401	1.24	13.979	1.50	11.202	1.76	8.999	2.10	5.265	3.40
19.085	1.25	13.842	1.51	11.120	1.77	8.752	2.15	5.184	3.45
18.783	1.26	13.708	1.52	11.039	1.78	8.519	2.20	5.105	3.50

QRP Clubhouse

Timothy Stabler—WB9NLZ wb9nlz@yahoo.com

Greetings to the readers of this column. As you may or may not know, writers of columns must get their work in early for publication on I am writing this in early November as in about one more week, I will get my right knee replaced and have been told I will not be too mobile for a while. I did put out a "panic call" to every group I had an email address for and although not published in qrp-l, I got a pretty good response and want to thank everyone who wrote. If I did not write your group, please send me the address and I will add you to my contact list. Also include how to sign up to get your various daily or whatever emails. The XYL and I are still not in our new home but I have heard Monday or Tuesday of next week is the move. Just in time for surgery. A former student is doing the job and I have full confidence in his work.

I know this is a "club" column but every once in a while I get something from an individual I think is worth passing on. Here is a couple.

Keith Price, WA5LPW, has been a ham for four years and into CW for three. Initially intimidated, he has built several kits from Doug Hendricks and gotten hooked on kits. He admits this is a wonderful side of the hobby, which I am sure we all know, and has set up a website at www.keithpricephotography.com/wa5lpw.htm.

Another entry was from Pete Juliano, N6QW. He recently finished a tri-band QRP rig he refers to as a Heath HW-100. A few days ago, he finished a 40M QRP CW transceiver using four gain block MMIC amplifiers from TriQuint semiconductor (Mouser) in a 3 × 4 × 2.5 inch package (www.jessystems.com/40M_MMIC.html). His first contact from the Seattle area was a station outside Boston which he thought was wonderful. On the drawing boards is a SSB transceiver using eight MMIC amplifiers. He expects the transceiver to be bilateral and as small as his CW transceiver. His main site is www.jessestems.com for a look at his SSB QRP transceivers.

G-QRP Convention 2009

The G-QRP Club held its annual convention at Rishworth School, in the north of England in October. This was a one-day event with all the elements that you might expect. There were vendors selling QRP friendly components and books, a display of homebrew equipment, lectures by a range of internationally renowned QRPers, a Buildathon and lots of social interaction over coffee, cake and the now famous "pie and peas" lunch.

Some 270 amateurs attended the day, including QRP ARCI President and immediate past President and the whole thing was hosted by George Dobbs, G3RJV. QRPers from USA, Scotland, Sweden, Norway and Belgium were also spotted in the crowd—truly international QRP.

The lectures were very well attended. Rex Harper, W1REX, who was over in the UK for the first time, gave an excellent introduction to the PICAXE microprocessor—apparently they are very versatile, and cheap. Ron Taylor, G4GXO, spoke about the development of a good 70 MHz SSB transceiver for his club and Ken Evans, W4DU, talked about QRP in the USA. Hans Summers, G4UPL, came out of the QRP Hall of Fame to talk about his QRSS exploits and David Stockton, GM4ZNX, hosted another open question style technical forum. Some of the lectures were streamed on the internet via the British Amateur Television website and it seems they were watched across the globe.

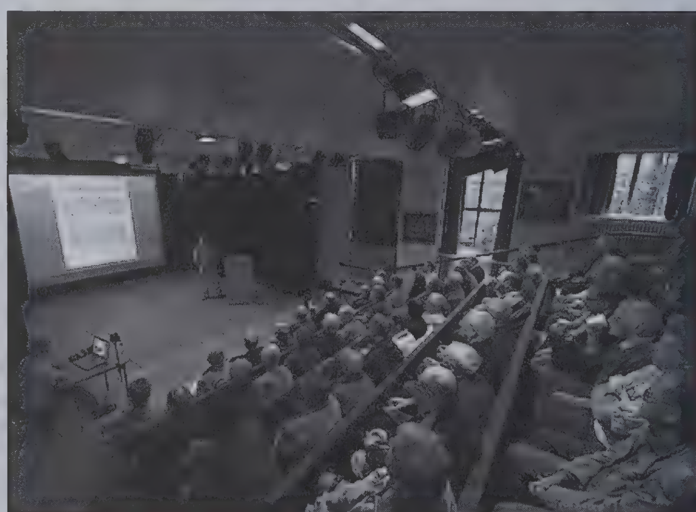
The Buildathon used the same project as this year's FDIM; a Manhattan version of the Sudden 40m direct conversion receiver. Twelve were started and by the end of the day all twelve were pulling in signals. A number of the builders were attempting a radio project for the very first time, but judging by the delight on their faces when they heard the first CW signals coming through, it won't be their last!

Congratulations go to George and all his team for organizing a hugely successful day.

3rd Bath Buildathon

Following hot on the heels of the successful 2nd Buildathon in Bath, England, the BBC (Bath Buildathon Crew) are planning a third event to take place just before Christmas. It is hoped to put another ten

Conversation at the G-QRP Club stand



W1REX keeps the audience's attention.

This youngster intently works on a Sudden Receiver.

Concentration seems to fit all ages at a Buildathon!

80m DSB transceivers on the air by the end of the day. The project is the Brendon transceiver from Walford Electronics, who sells a good range of QRP kits in the UK.

Many of the builders are working towards their UK Intermediate License, which requires all students to build a radio project before they are allowed to sit the written exam. Others are attending to improve their soldering skills under the supervision of some more experienced amateurs.

The previous event was filmed and a DVD was produced to encourage other groups to arrange their own Buildathon. So far, copies have gone to clubs in six different countries and it seems to be having the desired effect. Moves are afoot to make the film available on the Internet but if any clubs would like copies sooner, send a couple of dollar bills to cover the costs to QRP ARCI member Steve Hartley, GØFUW, who is QTHR.

Midwest HomeBrewers and QRP Group

The Midwest HomeBrewers and QRP got a table at the Ak-Sar-Ben flea market held Saturday the 3rd at the Nebraska Crossing outlet mall located just off of I-80 near the Ashland exit (about half way between Lincoln and Omaha Nebraska. The group set up the table with loads of QRP Gadgets, nothing for sale, just for looking, touching and asking questions. The showing was good and the folks managing the table enjoyed answering all the questions about QRP and operating. Several visitors expressed interest and thought the display was very interesting. We figure there will be some new faces at out next get together.

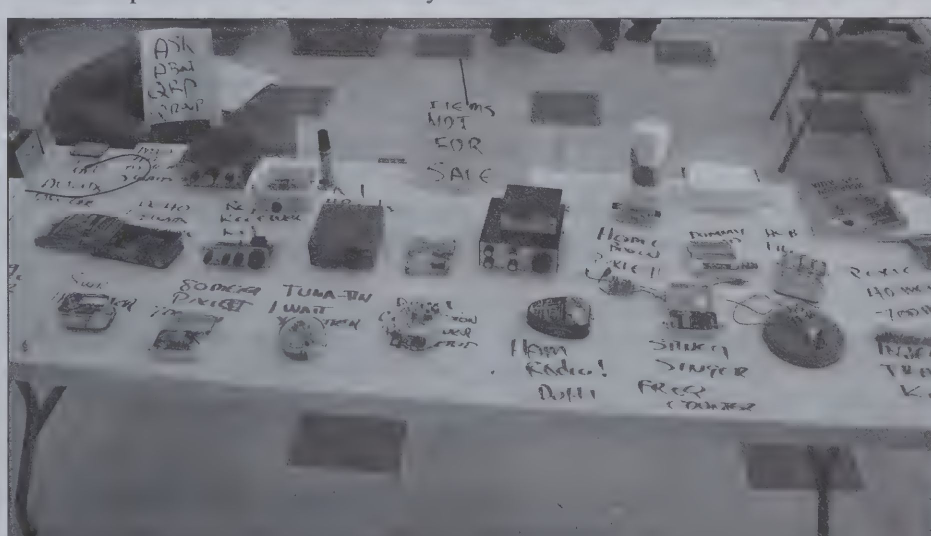
The Midwest HomeBrewers and QRP group meets the second Saturday of every month now in Ashland, Nebraska at the Breadeaux Pizza place. The kind folks at Breadeaux Pizza, let the group use the back room and allow them to solder whatever. And of course, everyone has to sample a Pizza or two!

Austin TX QRP club

Locally, the Austin TX QRP club has been playing with the Si570 type chips in making VFO circuits and other interesting applications.

The latest derivation was to take the VFO capability of this chip and develop a circuit to replace the 20 MHz Master crystal in a 802.11b Wi Fi wireless router to better operate in the 2.4 GHz ham band. This is a project for the High Speed Multimedia digital special interest group of Austin Amateur Radio Club. They are very active in taking off the shelf 802.11b equipment and adapting it to QRP outdoor use in mesh networks in support of ARES communications among local hospitals and EOCs. The pair of rubber duckies is replaced by low loss coax to gain antennas with the transceiver mounted right at the antennas in a plastic weather proof box. That is the point to point application of the 802.11b hardware.

Bar B Que grill antennas from a defunct cableless TV service provide enough gain to link over fixed 10 mile paths. Commercial gain collinear verticals make mobile to mobile links. The mobile



The Midwest Homebrewers and QRP club had quite a display at Ak-Sar-Ben.

802.11b work provides a unique store and forward network, akin to use of satellite platforms for store and forward data applications. Data up loaded at one mobile location can be linked into an internet when the mobile is within range of an access point when it moves further down the road.

The "feedline" on the Bar B Que grill fixed antennas becomes the cat 5 network cable to the computer at the portable site, or at a home shack. With power over Ethernet, the transceiver at the antenna receives its DC power from a ground location.

Back to the crystal substitution: Moving the Master crystal allows moving all the RF output of the 802.11 transceiver into the 2.4 GHz ham band instead of on just a few channels. A shift near 19 MHz was found to work adequately, and turned out to be the lowest cost crystal at the surplus store. Of course, a slide band transceiver as these are being called, must talk to another similar modified transceiver, but a simple switch can allow one unit to work 802.11b standard or "slide band." The leads to the switch become part of the oscillator circuit, thus the ability to work with SMT parts and precise lead lengths is a big plus. The sale of magnifier lights locally, has jumped accordingly!

Sparking the HSMM group VFO work has been Glenn Currie, KD5MFW, Bob Morgan, WB5AOH, and Lloyd Crawford N5GDB, who came up with the switchable "slide band" transceiver modification.

4 State QRP Group

AAØZZ EZKeyer—The big news at Four State last quarter was the introduction of the AAØZZ EZKeyer. It has been enormously popular with the first run nearly selling out in the first 48 hours. Another run is underway and the kit will be available for a long time to come.

This kit is an ideal first kit to build. It is inexpensive, has a small number of through hole parts and the pc board is uncomplicated. The manual is very complete with the command list, "how to" tips, and an Altoids installation tutorial. The full description, documentation, and ordering information is here: http://www.wa0itp.com/aa0zzkeyer.html

Weekly Nets—The Four State QRP nets meet each Wednesday beginning at 8:00 PM CST 0200z, NCS is WAØITP. CW speeds run 15 - 20 WPM, and straight key ops are always welcome. Participation continues to climb, with many regulars each week. We have multiple nets on the same night, which is a little unusual, but draws out ops with different interests and station capabilities. Checkins from NC, NJ, as well as the Heartland are common. The schedule is:

8:00 PM Central ... Comfortable CW Net , 3562.5. at 8:00 PM Central. If necessary to QSY we move up a half kHz at a time until we find a clear spot.

~8:30 PM Central (or after the 80M net is done) … We Qsy to 160M to the qrp freq of 1810. Again if it's necessary to QSY we move up a half kHz at a time until we find a clear.

9:00 Central ... PSK Net on 3580.5 We call it the PSK Wednesday Warble because the net began years ago with the participants using Dave Benson's Warbler. Ifyou like PSK, this is the place to be on Wednesdays. If the frequency is busy we QSY a 100 hertz at a time to a clear spot. Please consider this an official invitation to participate in the Four State nets.

Kitting Farm Out—With the introduction of six new kits so far this year, the kitting and shipping effort became much to much for one person to handle. So a call for help was posted on the Four State reflector and several members jumped to the rescue.

N5KDO, Rex Terry, is handling the AAØZZ EZKeyer from Tulsa, OK;

W5VAF, Dennis Smith, Jonesboro, AR is shipping the Clear Top Tins and Dummy Load;

NØNBD, Paul Smith, is kitting and shipping the VRX-1 receiver out of Humboldt, KS;

The Test Set is being kitted by the monthly meeting group at Barney's restaurant in Seneca, Mo, and shipped by WØCH, Dave Bixler; and

WAØITP is currently handling the NS-40 and the EM Manhattan Islander audio amp.

Our organization is widely distributed, as many others are also, and distributed kitting is working well for us, thanks to these fine hams who stepped up to the plate when needed. More have volunteered as more kits are coming, stay tuned. More kit information is on our web site kit page http://www.4sqrp.com/kits/kits.htm

Brutus Bash—On August 24, 2008 Bart Lawson WØIIT, Joe Porter, WØMQY, and I spent a very enjoyable afternoon operating portable on the Big Brutus Museum grounds near West Mineral, KS. Big Brutus is a gigantic electric coal shovel. We dubbed the outing the Brutus Bash and vowed to make it an annual event. This year it was scheduled for the same time frame but vacations and other issues forced a postponement to early October. Then week long torrential rains in the area eliminated all hope of the event this year.

So to make a positive out of the situation, we've rescheduled the event for Spring 1020. Look for an announcement on the reflectors. This is a great outing, way out in the countryside in a very pretty Kansas prairie area. Many ops were lined up for the fall outing and many more will attend the Spring "Bash."

The grounds sport a nice museum, BIG Brutus himself, shelter houses, and camping facilities. More information is here: http://www.wa0itp.com/bigbrutus.html and here http://www.bigbrutus.org/index.html

If you're in the area during the event, please join us for great day of portable QRP. —*WAØITP*

Guess that is about it for now. I am hearing all kinds of time for rehab but want to be mobile as soon as I can be. Will be still looking at emails so keep in touch. Remember Masscon (www.masscon.org) is slated for March and Ozarkcon the first of May. I expect to be at both. Will I see you there?

VHF QRP: A QRP Frequency for 6 Meters

Bob Witte—KØNR bob@k0nr.com

It has been a long established practice to have specific "QRP Activity" frequencies designated on the various ham bands. These are listed on the QRP ARCI web site (see reference below). In recent years, the 6 Meter band has not had a designated frequency. In October 2009, the QRP ARCI Board adopted the following QRP frequencies for the 50 MHz band:

50.096 MHz	CW
50.185 MHz	SSB

QRP Center of Activity by Band and Mode

Band	CW	SSB	Notes
160m	1.8101.843	1.910	Europe
80m	3.560	3.9853.690	Europe
60m	—	5.3465 (Channel 2)	U.S.A.
40m	7.030	7.2857.090	Europe
30m	10.10610.116	—	
20m	14.060	14.285	
17m	18.096	—	
15m	21.060	21.38521.285	Europe
12m	24.906	—	
10m	28.060	28.88528.360	Europe
6m	50.096	50.185	
2m	144.060	144.285	

PSK: Keep to the top end of the usual PSK frequencies

Background

I first commented on this issue back in the Summer 2004 issue of *QRP Quarterly.* The existing QRP frequencies for 50 MHz had real problems and were really not useful. This topic went dormant until President Ken Evans, W4DU recently raised the issue again. Ken sent me an email asking for a 50 MHz QRP calling frequency proposal for the board to consider. I bounced the idea around with some of the usual suspects and also received some valuable feedback via the vhfqrp yahoo group.

The first question we should ask about a 50 MHz QRP Frequency is do we even need one? And if so, what is its purpose? Many people have pointed out that the band openings on VHF are less frequent than the HF bands, so the main objective when operating is to simply find any activity, QRP, QRO or whatever. Just give me some decent propagation, so I can work someone! So the argument goes that we should all just listen to the standard calling frequency (50.125 MHz) looking for activity and be happy with that.

I see the HF QRP frequencies as "places where like-minded QRP operators go to make contacts," so a pair of 50 MHz QRP frequencies would serve the same purpose. Certainly, there are times when we will be looking for any old contact and the QRP frequencies will be ignored. But if you want a place to do your QRP thing with like-minded people, these frequencies are identified as the place to be.

Which Frequency?

In choosing a QRP frequency for 50 MHz, we wanted to be consistent with the HF bands. For example, we wanted to follow the general theme of "6" in the CW frequency, such as QRP frequencies of 14.060 MHz and 18.096 MHz. Similarly, the SSB QRP frequencies tend to end in 85, such as 14.285 and 21.385 MHz.

While it is good to have some arbitrary consistency in the frequencies chosen, it is even more important that they are compatible with existing band plans and common usage. For instance, the frequency of 50.060 MHz is down in the beacon subband, so that wasn't going to fly. Ultimately, the proposal settled on 50.096 which is high enough in the band to avoid the beacons but not get into SSB territory. For the SSB frequency, it needed to be up above the normal calling frequency of 50.125 MHz, which leads to the question of how far above it? A frequency like 50.130 MHz would likely just get tromped on by spillover from the 50.125 MHz, so moving further up the band makes sense. The frequency of 50.185 MHz followed the "85" theme and got the frequency far enough up the band to provide some separation from 50.125 MHz. As far as I know, these frequencies are compatible with band plans worldwide.

Many people had input into this decision but I'd like to especially thank Chuck Carpenter, W5USJ and Steve G4GXL for their assistance.

What about 2 Meters?

There has been no action on changing the QRP frequencies for 2 Meters. The QRP ARCI web site currently lists them as 144.060 MHz for CW and 144.285 MHz for SSB. Both of these frequencies have problems with existing band plans, especially when you look worldwide. In turns out, there is less consistency in the usage of 2 Meters in different countries, so any designated QRP frequencies would likely have to be unique to each region.

References

QRP Frequencies on the QRP ARCI web site: http://www.qrparci.org/content/view/4304/128/

Vhfqrp Yahoo Group: http://groups.yahoo.com/group/vhfqrp/

No matter what the frequency or mode — QRP is always fun (and sometimes challenging!)

Encourage your non-QRper friends to "turn down the power" and join in!

WSPR, SDR and QRP

Preston Douglas—WJ2V PDouglas12@aol.com

This article is about using WSPR, what it's all about, and how it integrates with modern SDR technology. WSPR (pronounced "whisper") stands for Weak Signal Propagation Reporting. The short version is that WSPR is an automated system for listening and beaconing in a very limited bandwidth, using highly sophisticated software for detection and signal processing. The software can be configured to automatically upload received information to a common web site (http://wsprnet.org/drupal/) where users world wide can view these "spots."WSPR signals are 6 Hz FSK signal and are confined to a 300 kHz segment in a band. "Spots" as they are called, are available for propagation study. Remember Chuck Adams' 30 meter propagation study? Well, this is a computerized, all band, automated, narrow bandwidth version.

The other part of this perfect pair is SDR. SDR is the moniker for Software Defined Radios, or radio systems that physically do no exist except as virtual radios inside our computers. So, this is about the marriage of these two technologies.

WSPR is a program written by K1JT, the same Joe Taylor who won the Nobel Prize for physics. According to the online WSPR website, K1JT's WSPR station "spotted" my one watt WSPR signal on 30 meters this morning, and he has "spotted" it several times before. It's pretty special to see his call on my spot list.

As frequently happens, technology builds on top of the new art that comes before. Thus, without the invention of light sensitive camera devices, the Hubble telescope would not have been possible. Indeed, I have read that WSPR was created from software ideas that were originally used in the radio astronomy studies that helped win Joe Taylor the Noble Prize.

In our own shacks, digital readouts have changed how we can measure the frequency of our equipment, both for receiving and transmitting. Twenty-five years ago, the best rigs you could buy had a frequency resolution of 1 kHz. Nowadays, even old rigs can be updated with digital readout. In my shack, I now have an FCC-1 digital dial connected to my old FT-7 QRP radio, so I can set it quite accurately to the nearest 100 Hz. There really is no more need for crystal calibrators every 100 kHz like they had in those old rigs. By the way, according to my FCC-1, the FT-7 does not seem to drift very much at all, so it was a very good design for its day.

But all modern equipment has a digital dial, and resolution to the nearest 100 or even 10 Hz is common. The more sophisticated equipment can resolve one Hz.

I have a new Genesis 3020 (see http://www.genesisradio.com.au/) about which I will include some remarks in this article. It is not, however, the intention to do a full review. Suffice to say, it is a neat kit, and an inexpensive way to build an excellent SDR radio. SDR, is one cornerstone of this discussion, though. While you can certainly run WSPR with a modern ICOM, K3, or the like, SDR is a very good technology for both QRP in general and WSPR specifically. SDR radios can be at once, accurate, precise, and highly sensitive. The high end for this kind of radio has been, in recent years, Flex Radio. Now, with the advent of SoftRocks (see below) and Genesis, as well as others, there are low cost, high performance radios available in the niche below the Flex Radios.

A few days ago, one of the folks on the QRP-L mail list mentioned how he was trying to WSPR with a Bitx20. While it's not impossible, particularly if he had a digital frequency readout, it would be challenging. The WSPR system needs to be accurate to within a few Hz, perhaps to the nearest ten, and it must drift less than 3 Hz over two minutes. That's a tall order for any analog rig, let alone a rig based on a homebrew analog VFO. Without a way to read out the dial with digital accuracy, this would be very difficult. GØIMX reported on the BitX20 Yahoo Group that he'd done it after installing a VFO stabilizer circuit, and he reports using the IW3ICH/B CW beacon on 14.0980 MHz and then tuning the beacon to display at 2320 Hz using SpecJT. Note that using a computer program like SpecJT is the equivalent of a digital dial. Nonetheless, this is quite an accomplishment with a BitX20!

SDR is at the other end of the spectrum of technology from simple analog transceivers. It uses crystal control, or crystal controlled synthesis technology to generate its oscillator signals. The heart of these SDR radios is a direct conversion receiver with two audio pathways generated in the mixer, one of which is 90 degrees out of phase with the other. This is not particularly difficult (easy for me, the non-engineer, to say), though good mixing with these requirements is made easier by yet another modern development, the Tayloe mixer. In any case, a handful of chips in these SDR radios convert the RF signals to audio, and your computer can take it from there. Figure 80% of the radio is running around inside your computer. Consider this: HF signals run up to about 30 MHz. Your modern computer is running at maybe 3 GHz. Think how much faster that is, and what such a machine can do with a simple audio signal in the 3K range.

In addition to its usefulness in WSPR applications, the SDR interface is sensational for all the other modes too. Even the simplest of these SDR radios presents an interactive panadapter that can be tuned by multiple methods, mouse, wheel, or buttons. Interactive is the key word here. It's not just a panadapter that shows you the signals. It's interactive, so you can go to the signals you see on your screen.

So, why is an SDR rig so ideally suited to this WSPR mode? Well, for one thing, SDR radios are quite capable of precision and accuracy to resolve a single Hz. The functional bandwidth of the WSPR subband on each amateur band is only about 300 Hz. Thus, with WSPR, it is necessary to set the radio's dial quite accurately. WSPR "spots" are reported to the nearest Hz, and you can see who's off when you look at the reports online. I know, for example, that my dial is about 10 Hz off. This will have to await further work in my shack to bring it in closer. But you can't set a dial to the nearest kHz and expect to hit the WSPR band. By the way, actual WSPR signals are 6 Hz wide, so a passel of them can fit in a 300 Hz band without stepping on each other. That's much narrower than even CW.

The advantage to using a phase modulated, extremely narrow signal in WSPR is that, with the aid of good signal processing, signals that are far, far below the noise

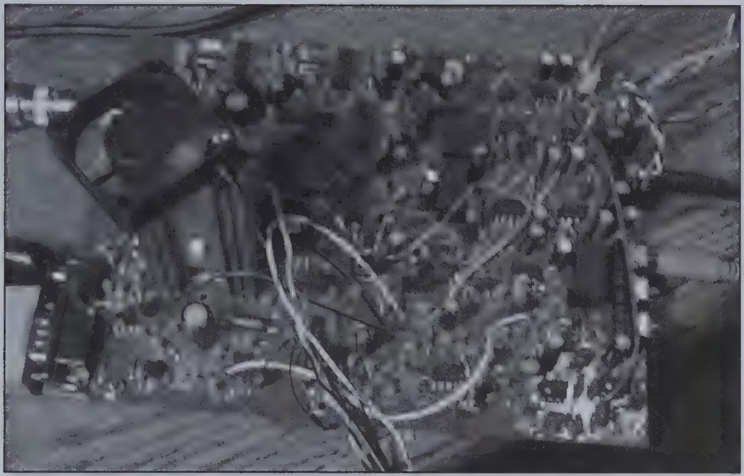


Figure 1—The Genesis 3020 SDR radio.

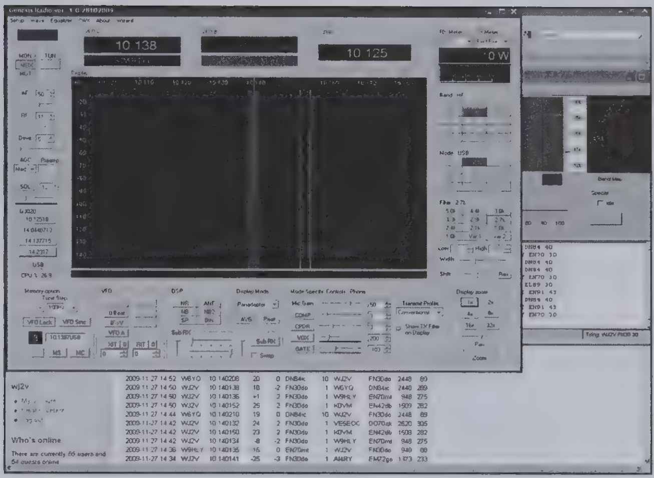


Figure 2—Screen shot of the G1.1 operating software.

level can be resolved. I have detected WSPR signals with a signal to noise at –28! Thus, while you may never hear some WSPR signals, your WSPR system will log them in. It is quite remarkable. The WSPR software is so sophisticated, that it does not matter how wide you set you filters in the receiver. It will resolve the incoming signals, regardless.

WSPR is free. Download it from the website at: http://www.physics.princeton.edu/pulsar/K1JT/

Then, go to the reporting site at: http://wsprnet.org/drupal/

You can WSPR with your main shack radio, so long as its dial is really accurate. This means zeroing the dial with WWV. You must also set your computer clock dead on using the NIST site that is built into your windows clock program. A few seconds off, and you won't be spotted. Finally, you must carefully set the parameters in the WSPR program, so you will be reporting your power output, frequency, and band correctly. This is relatively self-explanatory if you drop down the menus. There's also help online at the WSPRnet site, with an IM chat system always there.

Now, using SDR and WSPR together is more difficult, and probably more rewarding than WSPRing with your Yaesu. You can set your computer up so the audio from the SDR receiver is routed inside the processor/soundcard as a WAVE file, directly to the WSPR program, without extra cables, modems, or interfaces. You don't need them. The computer can re-route everything from that virtual radio to the WSPR program. The thing that's hard to visualize is that the screen that functions as the face of the radio is more than just a picture. There is a whole virtual SDR radio running in your computer behind that picture, and it can send its output wherever you tell it to. The toughest part may be learning how to get Windows and the sound card software to do what you want them to do with the audio.

There a few good programs for SDR now. The whole Power SDR line is based on Flex Radio's generosity in making its brilliant software available for other users. I like to use either PSDR40 or the new Genesis 1.1, specifically designed to work with my Genesis 3020. These are both free software. PSDR40 can be found in a link from the G4ZFQ site given below. The G1.1 is available from Genesis or their Yahoo Group files. Now, I won't say figuring out how to tell your computer how to route the various signals, and which drivers to use is easy. It drives most of us mortals half-crazy until we get it all figured out. You won't believe how much new stuff there is to learn.

About new stuff. If you only like dials with hatch marks every five kc, bugs, CW, and loading the finals, that's fine for you. Actually, I like that stuff too. One of these days, I am going to buy myself a Knightkit T-50. But the cutting edge is where we hams have always liked to be. This SDR and WSPR stuff takes a lot of learning, and it often doesn't work right off the bat, even when the hardware is built and hooked up correctly. My computer has different hardware than yours does. I had to learn how to integrate my two sound cards, so they can pass audio data between them. Most users have one sound card with multiple inputs, so mine was different. There is a lot of help out there, but it takes reading and (oh no, I'm too old for that!) study. If your ham career is in the shallow end of the pool, then that's fine. If you want to really surf, then this is where the good waves are.

The site: http://homepages.wightcable.net/ ~g4zfq/Si570.htm will give you a ton of information about the current state of SDR. It is oriented largely to SoftRock kits (which are really wonderful, and make radios that are competitive with very expensive conventional rigs, despite their embarrassingly low prices.) And see specifically this site for routing audio to WSPR and other programs from SDR radios: http://yt1dl.veze.net/sdr.html

These two sites will either light up your interest, or scare you away.

OK, so what does WSPR look like at my shack?

Figure 1 is a photo of my Genesis 3020 in action, still naked without a case. Note the oversized heat sink and fan, necessitated by the long (two minutes at a time) key down time WSPR requires. Kit price is about $170 American, ordered from Genesis, in Australia. Good folks to deal with, and great support in their Yahoo Group. This is a big kit, not for beginners, but worth the hours of build time, and no surface mount parts.

Figure 2 is a screen shot of the G 1.1 software screen, showing what the "face" of the radio looks like when you're operating. Note that the VFO is set for the 30 meter frequency of WSPR, 10.138600. That's right, it is set to the nearest Hz.

Figure 3 is a screen shot of WSPR in action, running simultaneously with the G

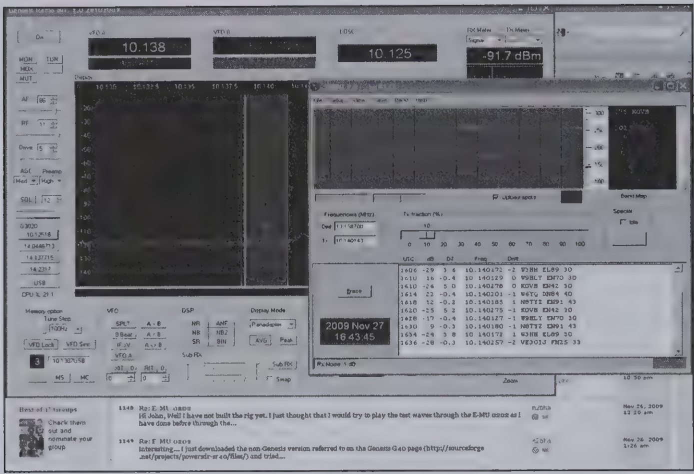


Figure 3—WSPR in action.

Figure 5—Map view of "I heard" and "heard me" stations.

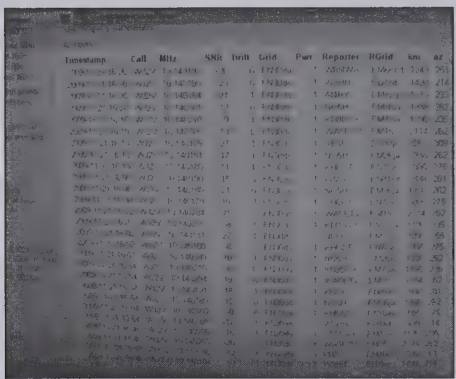


Figure 4—Downloaded database listing from the reporting site.

1.1 Power SDR software, which is still running in the background. Note on the top line, at 1606 UTC, with a SNR of –29, I spotted W3HH while he was running 1 watt.

Figure 4 is a screen shot of my spotting database on a single date, showing who spotted my 1 watt signal, and who I spotted on receive. My system is set to beacon about 25% of the time and listen 75%. On 30 meters, I use a tuned-fed doublet.

Figure 5 is a screen shot of the world map function of the online WSPRnet.com reporting site, showing where I've been heard, and where I hear from. For sure, one watt goes a lot farther in WSPR mode than it does in SSB!

I'm running one watt for WSPR. In less demanding modes, like CW and SSB, the Genesis will do at least 5 watts out. Of course, I built my Genesis3020 transceiver kit, and for that matter, I built my 3 Gig CPU/3Gig RAM computer from components. All the software, except for Windows XP, was downloaded from the Internet, for free. So, yes, this is definitely QRP.

You can get your feet wet to see if this SDR stuff is for you by building a SoftRock receiver for about 15 bucks. (See: http://www.kb9yig.com/) Now, this site is tricky, because the sole proprietor isn't in this to get rich. He puts up a set of kits and changes the "check back soon" sign on that item to indicate its availability. Kits often sell out again in only a few hours. So, if you're in the market for one of these kits, you have to keep checking the site, sometimes all day long for days. Some smart folks set the site up as an active desktop on their computers. Note there is an excellent SoftRock transceiver, the RXTX 6.3, which, with necessary auxiliaries to run it on all bands, will run over $100. I am in the process of building mine now. I'll let you know how I do, but I can tell you that this is a complex project. Get your feet wet first with a receiver kit. If you fail with it, you've lost the price of a corned beef sandwich and a soda. The little $15 SoftRock receiver you can build for so little money is not a toy. It will, with a fast computer and quality sound card, make you a very high quality single band receiver. You will have trouble believing that that little thing, and your computer, can comprise such an impressive receiver. I used my SoftRock receiver to monitor the 40 meter WSPR band, and I was impressed. Note, SoftRocks are surface mount kits, so, sadly, they are not for builders with vision or fine motor problems. The good news is that you can sometimes find built versions of the receiver kits for sale on the SoftRock site for about $40 (but not, as far as I know, the TXRX 6.3 transceiver).

Beginners in SDR often ask what modes can be operated with these radios. The answer, generally, is that all modes can be run in these radios. The G3020 and its ilk will run CW, SSB, SSTV, RTTY, and PSK31, and, of course, WSPR. After some weeks of messing with the various software, I have figured out how to do all these things with my setup. I have Ham Radio Deluxe interfacing with the PSDR software, so I can operate the Genesis as if it were indistinguishable from an FT-817 with CAT control, if I want to. And, DM780, which is part of the HRD package of software, works a treat. DM780 has the amazing multiple PSK31 browser that decodes a whole bunch of signals simultaneously. Again, settings must be tweaked, but the sites referred above will give you a very good tutorial in getting this stuff working. These sites require study and should probably be printed out so you can use them while you hack on your computer.

SDR has made operating even the basic modes modes like CW and SSB very different. I can see where the signals are, even see what they are. I can see if a guy is splattering. I actually think that using an SDR radio might be an unfair advantage in a CW contest because the operator can see all the signals on the band, at once. And, of course, a contester can see where there's a hole to drop in a CQ call.

Here's an opportunity for a ham with the intellectual curiosity and love of building radios to find a new happy place. I highly recommend it.

The QRP-ARCI Toy Store

The **Official** QRP-ARCI Coffee Mug. Used by the top QRP Fox Hunters, contesters and casual operators found near the normal QRP Frequencies.
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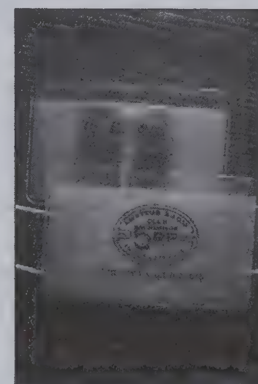

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See http://www.qrparci.org (QRP Toy Store link) for pictures

A Frequency Counter Project: Part 2

Dieter (Diz) Gentzow—W8DIZ w8diz@tampabay.rr.com

In this Article, we will design a Frequency Counter and create schematic using free tools from http://expresspcb.com and http://atmel.com. We will assume that you are using Linux Mint for this project but you may also follow the project using Microsoft Windows XT or Vista. For these series of articles, it is assumed that you have built qrp kits, can solder and have used a text editor. You should also have access to a high speed internet connection because the size of the PDF document files you need to download are one to two megabytes. It is the intent of these series of articles that anyone having the above tools and knowledge should be able to follow the articles and produce schematics, create a PCB layout and write/copy code and upload the code to a hardware platform, producing a fully functioning Frequency Counter. Note that addendums and/or corrections to this project are available at http://w8diz.com/qq-fc-project/

Download Tools and Documents

If you are running Linux, go to http://w8diz.com/qq-fc-project/part-2/ and install WINE first, followed by EXPRESSPCB. If you are on a Windows machine, go to http://expresspcb.com and download and install their free CAD software package. In both cases, install EXPRESSPCB using all the default settings. Download Documents to your Desktop.

The Heart of the Project

The ATmel AVR ATtiny2313-20 is a powerful microcontroller. One of it's features is the ability to count external clock pulses at a rate of 45 percent of the internal clock frequency. If we use an internal clock frequency of 20.48 MHz, we can count an external clock source up to about 9 MHz. Officially, ATmel recommends 40 percent of the internal clock frequency, or about 8 MHz. Since we want to be able to count up to at least 30 MHz, we need to add a prescaler. The 74HC4040 chip has selectable prescale outputs and a maximum guaranteed operating frequency of 30 MHz. We will use the divide by 4 output (Q2) on PIN-7 of the chip. A 30 MHz external clock is divided by 4 for a maximum frequency input of 7.5 MHz to the AVR chip. See http://w8diz.com/qq-fc-project/MM74HC4040.pdf for more detail. The input of the 4040 chip requires a 5 volt peak-peak signal level. To achieve this level, we need to amplify the input signal. A simple way to accomplish the amplification is to use the input amplifier from a 74HC4046 phase lock loop chip. PIN-14 (Signal In) on the 74HC4046 chip has a special DC bias network that enables AC coupling of input signals. Input sensitivity is better (lower) than 100 mV_{P-P} RF. See http://w8diz.com/qq-fc-project/MM74HC4046.pdf

Learning to Use ExpressPCB Schematic Capture Program

Double-click the ExpressSCH.desktop icon on your desktop. Ref http://w8diz.com/qq-fc-project/expressSCH.gif Click on Help in the Menu Bar and review the User Manual and the Quick Start guide (Figure 1 shows the screen).

Play with all the buttons and try the examples and suggestions in the guides. When you think you can move around the schematic program, close the program and restart it. We will now create

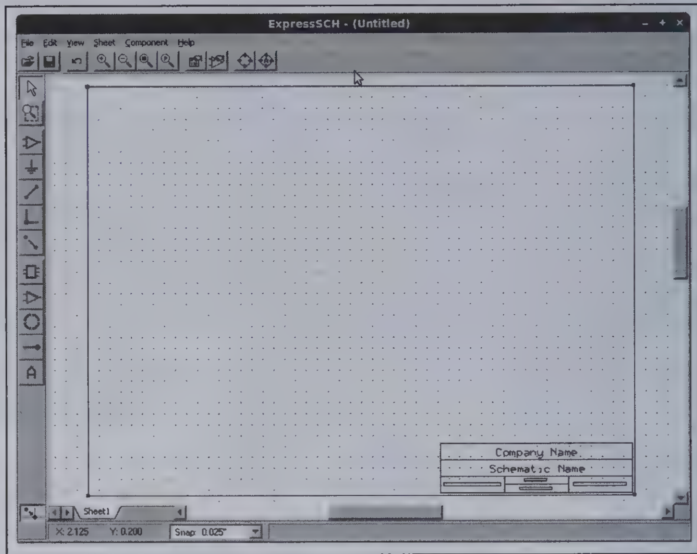


Figure 1

an IC component, the ATtiny2313. Ref: http://w8diz.com/qq-fc-project/ATtiny2313.gif (Figure 2).

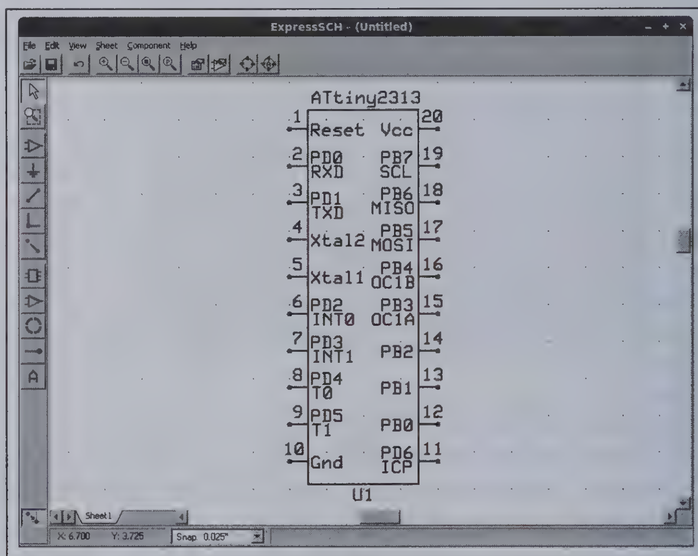


Figure 2

Start by maximizing you expressSCH window on you Desktop. Zoom-In by clicking the PLUS-SIGN magnifier button in the menu bar twice. Left click on the ADD RECTANGLE button on the left button bar. Place the CROSS CURSOR over one of the DOTS in the upper part of the window and press the LEFT mouse button while dragging the mouse lower and to the right to form a rectangle on the screen and then release the mouse button. Now let's resize the rectangle by left clicking on the ARROW button on the left menu bar. Place your ARROW CURSOR tip anywhere on the rectangle line (perimeter) and left-click it. The rect-

angle should now be colored BLUE and display 4 resizing points. Left-click on the points and drag your mouse at the same to resize the rectangle to 3 DOTS wide and 10 DOTS high. Note that the DOTS aka GRID is configured by clicking on View and then Options in the menu bar (Figure 3). Ref http://w8diz.com/qq-fc-project/options.gif

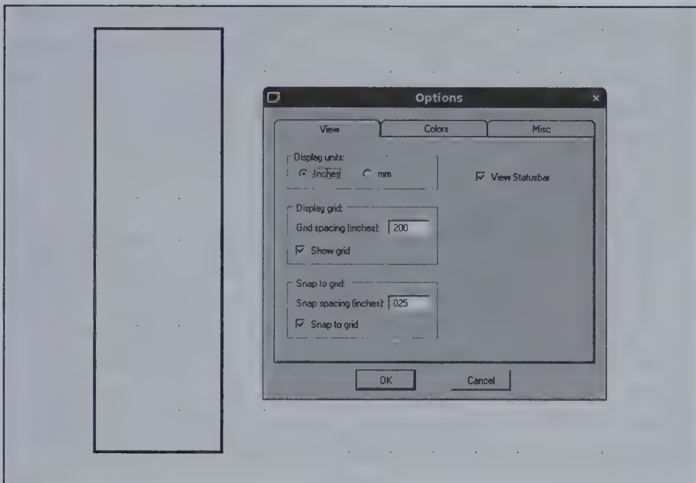


Figure 3

Left-click the mouse pointer on EXACTLY the upper-left corner of the rectangle and drag the rectangle to co-ordinates X: 4.700 and Y: 1.800 and then center the rectangle on the screen using the scroll bars.

We will now add 20 PIN connections. Left-click the PLACE PIN button on the left tool bar and place a pin at co-ordinates X: 4.600 and Y: 1.900 and then left click on the ARROW button on the left menu bar. Now double click the PIN dot to set its properties (Figure 4). Ref http://w8diz.com/qq-fc-project/setpin.gif

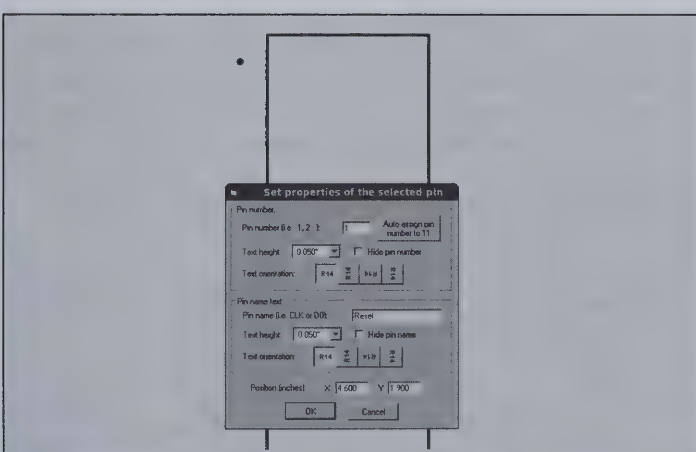


Figure 4

Change the PIN Number to 1, the PIN name to Reset and both Text Heights to 0.050 inches. Click OK. Click on the ADD LINE button on the left tool bar. Place your CURSOR ARROW TIP on the PIN dot, click the left mouse button and move the mouse to the right, up to the body of the rectangle and then click the left mouse button again and then finally click the right mouse button to disable the LINE. Click the ARROW button on the left menu bar and then click on the Reset tag name, keeping the mouse button down and drag the Reset tag word to match the picture below.

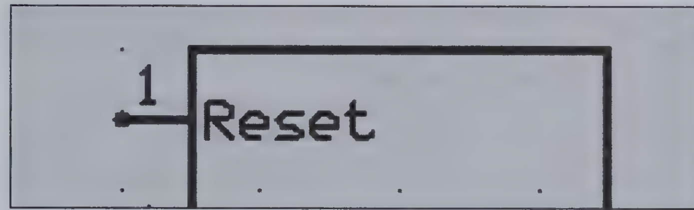


Figure 5a

Do the same with the pin number 1. Ref http://w8diz.com/qq-fc-project/pin1.gif

Now we will replicate (copy) PIN-1 to pins 2 thru 10. Left-click on PIN-1 once to turn it BLUE. Type CONTROL-C on your keyboard. Then type CONTROL-V on the keyboard. A copy of PIN-1 will display in the center of your window. Drag the PIN to the PIN-2 position. Repeat this step 8 more times to create all 10 PIN positions for the IC on the left side. The component should look like Figure 5b. Ref http://w8diz.com/qq-fc-project/copypins.gif

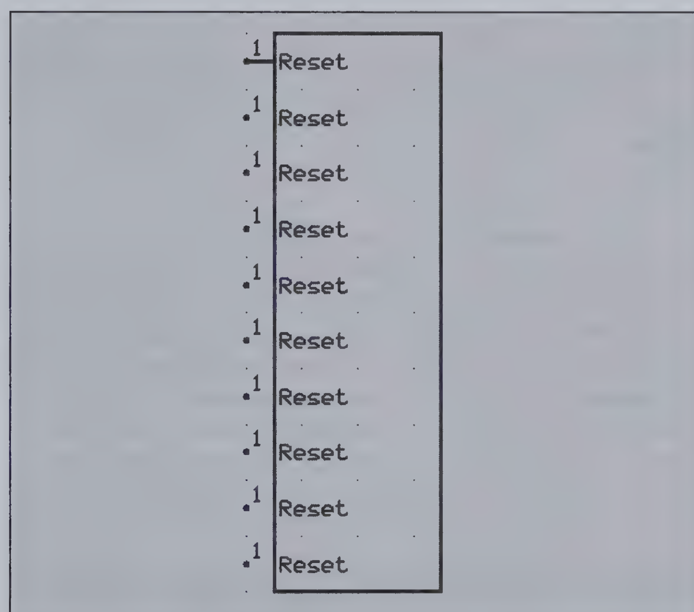


Figure 5b

Also copy the LINE form PIN-1 to the other PINS, Select (click on) the line at PIN-1. Type CONTROL-C on your keyboard. The type CONTROL-V on the keyboard. A copy of the line will display in the center of your window. Drag the LINE to connect PIN-2 to the body of the component.

Repeat for the remaining 8 pins. Now click on each PIN and renumber and rename then per http://w8diz.com/qq-fc-project/ATtiny2313.gif

Note that some of the PINS of my component have 2 names. You can add additional text at any time by clicking on the PLACE TEXT button on the left tool bar, entering your text in the input field at the top of the window and setting the text height to 0.050

inches and then placing the text by moving the mouse to the desired text position and left clicking the mouse. Once all the text has been added to the part/component, you may need to reposition/align the text on the component part. Repeat the above for PINS 11 thru 20 until your part looks like Figure 6. Ref: http://w8diz.com/qq-fc-project/2313.gif

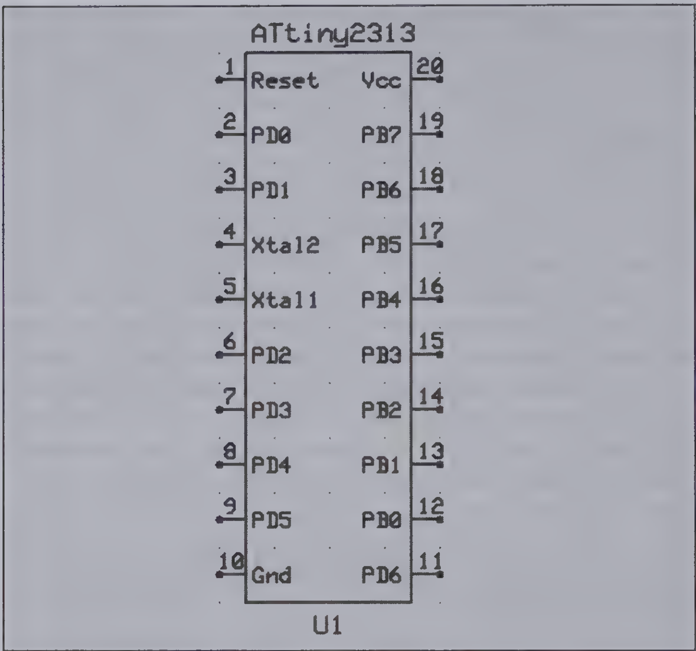


Figure 6

We are now ready to SAVE the component and assign it a real name. Click on the ARROW button on the left menu bar. Place the mouse cursor to the left and top of PIN-1, click the left mouse button and then drag the mouse to the lower right of the component beyond PIN-11 to create a rectangle that encompasses the entire component and then release the mouse button. The component should now be BLUE. In the MENU bar, click on COMPONENT and then click on GROUP TO MAKE COMPONENT. Set the properties of the new component and click OK (Figure 7). Ref: http://w8diz.com/qq-fc-project/new2313.gif

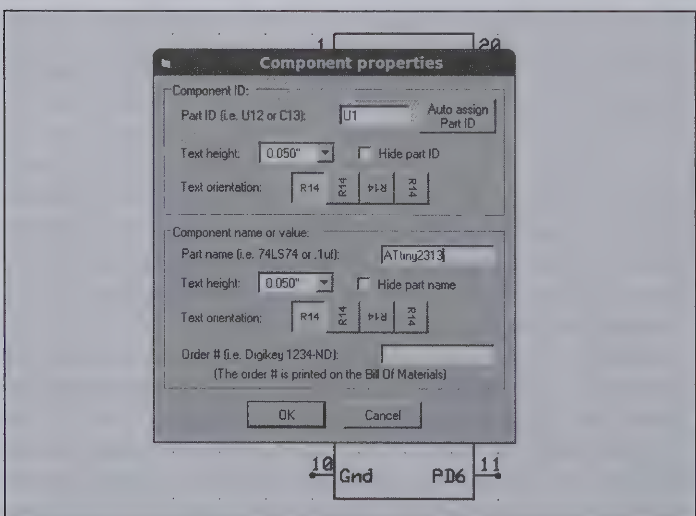


Figure 7

You have now created your first component for the QQ Freq Counter Project. Save your schematic by clicking on FILE, then SAVE AS and then select the ExpressPCB directory, then name your file "learning."

Time to Draw the Schematic

You now have the option of downloading the schematic that I created or create your own. May I suggest that you download my schematic and try and re-create it using your new skills? Then place the file QQ.sch into your ExpressPCB directory. See Figure 8, Ref: http://w8diz.com/qq-fc-project/ QQ_FC_sch.gif.

Circuit Description

The LCD is 16 character by 2 line with LED backlight made by Hantronix and sold by Mouser. A PDF document for the LCD is available at http://w8diz.com/qq-fc-project/hantronix.pdf. The LCDs backlight draws about 75 mA while the rest of the circuit draws about 10 mA. The backlight current is controlled by R7. To reduce current and brightness, change to 18 or 22 ohms. I use a 78L05 5 volt 100 mA voltage regulator and feed the regulator from a 9 volt source. If you wish to run the FC project from a 12 volt source, you must use a full size voltage regulator like the 7805, which can handle at least 1 amp and can dissipate more heat. The purpose of R1 in the power circuit is to drop 1 volt and limit the heat dissipated by the 78L05 regulator.

Using a 20.48 MHz crystal, we can directly measure (count) up to about 9 MHz without using a prescaler. I use a 74HC4040 binary counter to prescale by 4 and allow measurement up to about 36 MHz. The prescaler selection is 1, 2 or 4, jumper selectable. A PDF document for the HC4040 is available at http://w8diz.com/qq-fc-project/MM74HC4040.pdf. The input to the prescaler is 5 V_{P-P}, so we need a preamp. I use a 74HC4046, which will amplify less than 100 mV_{P-P} to the required 5 Volt level.

A PDF document for the HC4040 is available at http://w8diz.com/qq-fc-project/MM74HC4046.pdf. Overvoltage protection is provided by 1N4148 back-to-back diodes on the input. The R2/C4 network is a noise suppressor. I have included D3 on pin-8 of the CPU, an LED that we will use to test the operation of the CPU. J3 is the header connection that connects to the AVRISP programmer.

Building the Prototype

We are now ready to build a prototype Frequency Counter and here you have four or more options:

1. Order a PCB from http://kitsandparts.com
2. Order a complete kit from http://kitsandparts.com
3. Design and order your own PCBs from your favorite PCB house.
4. Create an ugly construction project using vector board or other techniques.

This project started out at my QTH using option 4. Pictures of the proto construction are available at http://w8diz.com/qq-fc-project/proto1.jpg and http://w8diz.com/qq-fc-project/proto2.jpg. I use wire-wrap-wire (available from Radio Shack in multiple colors) to interconnect all the components on the prototype. If you

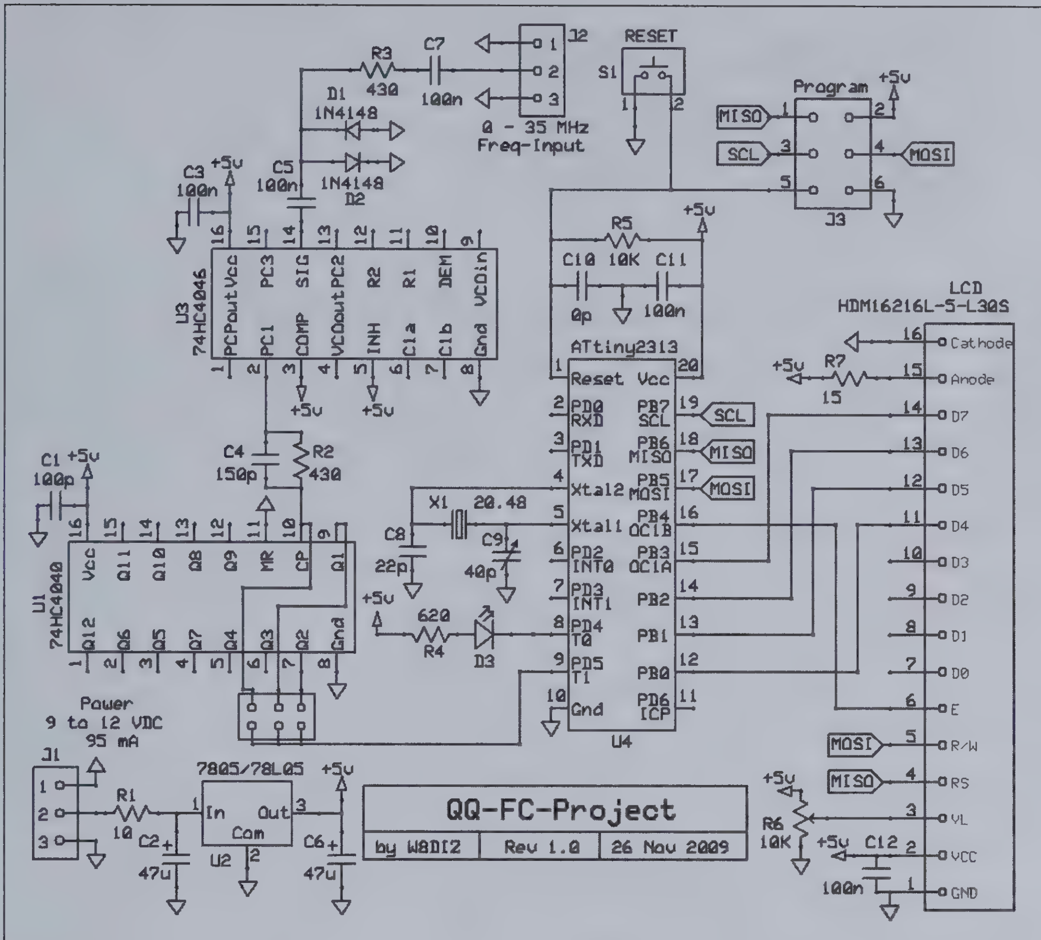


Figure 8

strip off about 3/16 inch of insulation from the wire, you can wrap it around an IC socket pin using a jewelers screwdriver to push/wrap the wire around the pins.

A complete kit of parts, including 2 CPUs, PCB and a backlit LCD is available for $28 from http://kitsandparts.com A picture of the PCB can be seen at http://w8diz.com/qq-fc-project/ QQ_FC_pcb.gif

Let's build the prototype in two phases; the first is to complete the prototype with all components to control the LED, D3. Build the prototype using all the parts shown in the schematic except all the components that connect up to pin-9 of the CPU.

After phase one is built, with both the CPU and the LCD NOT installed, apply 9 volts to the power connection and verify that you have 5 volts +/– 0.1V available at pin 2 of the programming header, J3. Once the 5 volts is verified, we can connect the LCD to the PCB and insert the CPU.

Again, DO NOT use a 12 volt power source UNLESS you are using a 7805 regulator.

Power up the FC and adjust R6, the blue pot so that you can see the character display. This will most likely be black squares for each character position. Now install all remaining parts per the schematic. Install the LED so that the body of the LED matches the pattern on the PCB.

At this point, we will review the QQ-FC project environment and requirements in the block diagram (with notes) in Figure 9. Ref: http://w8diz.com/qq-fc-project/ block-diagram.gif.

The LED source code is available at http://w8diz.com/qq-fc-project/led-code/led.asm The FC source code is available at http://w8diz.com/qq-fc-project/fc-code/fc.asm You will also need http://w8diz.com/qq-fc-project/fc-code/tn2313def.inc used by both asm files. Make sure that you have the AVRISP available for the next article.

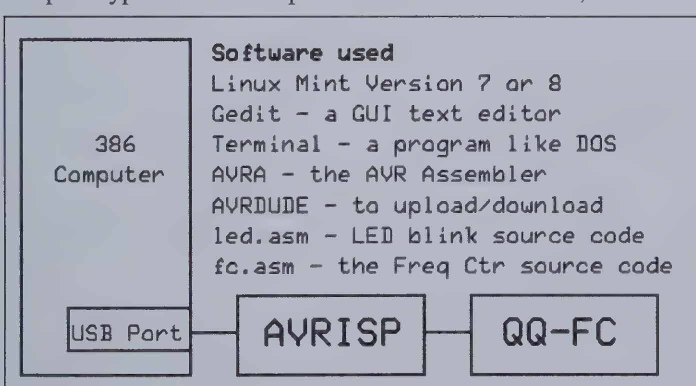


Figure 9

Next Article: **Making it all work together**

About the Author

Dieter (Diz) Gentzow, W8DIZ, aka WB8QYY before April 2000, has been a licensed ham since 1973. Original Member of the Flying Pigs QRP Club International, commonly referred to as Papa Piggie. Past employment includes Honeywell as an Industrial Sales & Systems Engineer, AC Nielson, Electrical Engineer designing black boxes that monitor TV viewing habits and a handful of other hardware and/or software jobs. Diz is currently semi-retired, living in sunny Palm Harbor, Florida. You can contact Diz, W8DIZ via eMail at w8diz@tampabay.rr.com

Notes

Addenda and/or corrections to this project are available at http://w8diz.com/qq-fc-project/

FDIM - XV
Four Days in May
2010

Thursday a full day of Seminars

Saturday Evening Awards Banquet Door Prizes

Four Days in May
May 13-16 2010
Thursday thru Sunday

Friday spend some time with vendors or attend one of our training sessions

- Registration and getting acquainted begins Wednesday evening.
- Seminars are most of the day Thursday, with "meet the speakers" and an open room for some casual show and tell and plenty of time to swap tales during the evening. Thursday afternoon will be the Build-A Thon (requires registration)
- Friday daytime is open to attend the Hamvention® and visit the QRP-ARCI Toy Store.
- Friday afternoon and evening activities usually include "show and tell", vendor displays and a judged home brew contest.
- Saturday is again open for the Hamvention. For the evening, and we have our great annual banquet, awards presentations and door prizes.
- Sunday is the Hamvention®, and check-out.

Thursday Evening Meet the Speakers

Friday daytime, take a break attend the Hamvention

Thursday Evening Casual Show and Tell

Wednesday evening Registration and get together

Thursday Afternoon Buildathon

Friday Afternoon and Evening Vendor Night Judged Competition Home Brew Displays

Saturday Morning Off to Hamvention or see the sights

FDIM Registration and Hotel Reservation

Much More! Watch the web site www.qrparci.org

Guest/Spouse Program

Home Brew Contest	Door Prizes
Build-a-thon	Discounted Hotel Rooms
Banquet	Complimentary Breakfast
Seminars	Hamvention just across town
Meet the Speakers	Nearby Restaurants
Vendor Displays	New Product Announcements
Discounted QRP Products	Spouse Program

This is preliminary information. Some changes will most definitely occur.
Please check the web site, www.qrparci.org, for the latest details and registration information.

12.14.2010

FDIM - XV
Four Days in May 2010

Get FDIM on your calendar now! Thursday-Sunday, May 13-16.

What a great FDIM we have planned for this year. If it's your first or 15th, there will be something here for you. QRP-ARCI is sensitive to the first time attendee and will try to make your first FDIM as fun and interesting as possible. We will also have spouse/guest activities.

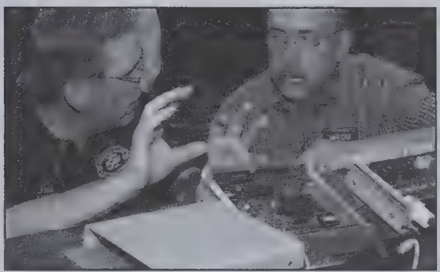
Seminars are most of the day Thursday, with "meet the speakers" and an open room for some casual show and tell, vendor displays and plenty of time to swap tales. We will also host a Build-a-thon Early Thursday Evening (tickets required). Most of Friday daytime is open to attend the Hamvention® and visit the QRP-ARCI Toy Store. We'll have plenty of room at the hotel for casual meetings and visits with old/new friends.

Friday evening activities include "show and tell," vendor displays and a judged home brew contest. Don't miss it!

Saturday is again open for the Hamvention, and we have a great social event, our annual banquet and awards presentation. There will be plenty of door prizes that evening.

On Thursday, we'll have a build-a-thon for a QRP project, a judged project contest ,and it shouldn't surprise you to find a contest or two during the weekend. We've had QLF, split paddle, and other fun activities in the past.

QRP related Vendors are invited to exhibit both Thursday and Friday evenings. We're sure you'll find many



interesting new products and a few special FDIM discounts.

We will again be at the Holiday Inn, Fairborn, OH. Reservations and special room rates for FDIM are available through Remember, all discounted hotel rooms are released only through QRP-ARCI. Just send an e-mail to us at QRPRooms@qrparci.org or visit www.FDIM.QRPARCI.org.

See you at FDIM!

Norm Schklar, WA4ZXV
FDIM2010 Chair

Four Days in May 2010:
May 13th, 14th, 15th, 16th - 2010

Speakers:

- Jim Everly, K8IKE
- Jay Slough, K4ZLE
- George Dobbs, G3RJV
- Hans Summers, GØPDL
- B. Scott Andersen, NE1RD

Topics will include QRSS; DXpeditions for the QRPer; Test Equipment; Homebrew receivers; along with some great humor and interesting tales.

Bus to Hamvention:

Last year's bus transportation to the Hamvention was a success. Bus tickets will be available for purchase this year at the hotel year.

Buildathon (Thursday, May 13):

This year's FDIM Build-a-thon event will feature surface mount construction and techniques designed to encourage hams that have yet to build a project using SMD. Participants will build a fully functional iambic keyer with a vast feature set that includes speed adjustments by paddle or potentiometer, 6 non-volatile memories with embedded commands, 4 keying modes, serial number generation, HSCW, QRSS, adjustable weight, adjustable letter spacing and much, much more. It can be easily added inside a transmitter, transceiver, or put into an enclosure as a stand-alone keyer. Its builder friendly layout will make it easy to construct.

The Build-a-thon will be held on Thursday, May 13 beginning at 4 p.m. EDT. Registration fee for this event is $30. This will include the project board and parts, solder paste, tweezers and elmering. Participants are asked to bring wire cutters, needle nose pliers, a small, fine-tipped solder iron and, if available, a hot air gun.

Space is limited to 30 participants.To register please visit the ARCI FDIM web page at http://www.qrparci.org. This year's event is being hosted by Chapter Three of the Michigan QRP Club and the project is being lead by Pete Meier, WK8S. For further details about the project go to http://web.me.com/pmeier/Build-a-thon_2010

Homebrew Contest—Show and Tell:

As with 2009, we intend to allow entries in the Homebrew Contest* to be displayed in the Ballroom on Thursday night, May 13; and Friday night, May 14, between 8 p.m. and 10 p.m. To enter an item in the contest and insure that it is part of the voting (on Friday night), you must register your item on either Thursday

or Friday night between 7 p.m. and 8 p.m. A registration table will be outside the main Ballroom at that time on both nights. Each entry will be given a card that lists the category and item number, along with a description of the item and the call sign of the owner. This card must be displayed with your entry.

Judging will be done between 8 p.m. and 10 p.m. on Friday night, so although you can display you item on both Thursday and Friday nights, your entry must be displayed Friday night to insure it is part of the voting. The judges will be the attendees of the Vendor night on Friday. Each will be given a ballot that must be submitted by 10:00 PM on Friday.

There will be six award categories:

1. All Homebrew (Xcvr, Xmtr, Rcvr)
2. Modified Kit (Xcvr, Xmtr, Rcvr)
3. Station accessories (homebrew or modified kit)
4. Test Equipment (homebrew or modified kit)
5. Antennas
6. Special Category
7. Best of show

The FDIM 2010 QRP Challenge

This year we have added a special category to the Homebrew Contest. It is called The FDIM 2010 QRP Challenge. The objective is as follows—Design and build a QRP Transceiver using the following rules:

- The transceiver is limited to a maximum of 72 parts.
- The receiver must be a superhet or other "single signal receiver."
- Keying and muting must be included.
- Covers at least one of the standard QRP Frequencies as listed at www.qrparci.org/qrpfrequency
- Capable of battery power for portable use.
- Schematic w/parts list and functional XCVR be brought (or sent) to FDIM 2010.
- Only one of the active components may be an IC, all other parts must be discrete components.
- Knobs, sockets, tuning dials, copper board, power source and enclosures are not considered parts.
- See http://www.qrparci.org/fdim72 for further details, including a FAQ section.

Winners will be announced at the awards banquet on Saturday, May 15. If you are bringing an item for the Show & Tell* and do not wish it to be judged, you need not register, simply come to the ballroom between 7 p.m. and 8 p.m. and set it up on a table that we will assign to you. Whether you are part of the Homebrew Contest or the "Show and Tell," please let us know your intentions when you register so that we can assure we have adequate space for all.

***Definitions:**

Homebrew Contest—You bring one of your latest projects and display it. On Friday night, attendees will be able to vote for a winner in one of six tentative categories.

Show & Tell—You bring one of your latest projects and display it. Your project will not be part of the voting in the Homebrew Contest

FDIM Event Schedule (subject to change)

Wednesday May 12th

7.30 pm - 9:30 pm—Registration

Well be in the Challenger room for registration. There will be tables set up for visiting with old friends or making new ones.

Thursday May 13th

7:00 am—Registration will be outside the ballroom.

8:00 am - 4:00 pm—Seminar in the Main Ballroom. This event requires Seminar Registration. Raffle tickets will go on sale during the break.

4:00 pm - 8:00 pm—Buildathon. Requires separate registration.

8:30 am - 5:00 pm—Stitchin' in Dayton. Alternate activity for the spouse in the Armstrong Room.Requires a separate registration; please see the web site.

7:00 pm - 8:00 pm—Homebrew Contest Registration. Setup display for home brew projects.

8:00 pm—Meet the Authors/Show and Tell (Main Ballroom) + Fun night + (Ballroom). This is a great opportunity to come out and visit with the Speakers from the days seminar as well as a chance to meet some avid QRPers. A few vendors will probably setup tables. There will be space available to bring your favorite amateur radio items for a casual show and tell. We'll be in the large banquet room and should have plenty space to enjoy the speakers, company, and equipment.

Friday May 14th

8:30 am - 5:00 pm—Stitchin in Dayton. Alternate activity for the spouse in the Armstrong Room.

7:00 pm - 8:00 pm—Homebrew Contest Registration. Setup display for home brew projects.

8.00 pm Radio Show and Tell—Meet and Greet (setup 7:30-Ballroom).

7.30 pm—Vendor setup at in Ballroom

8:00 pm—Vendor Night open to public.

8:00 pm—Homebrew Display and Judging (Ballroom).

Saturday May 15th

Hamvention!

8:30 am - 5:00 pm—Stitchin' in Dayton. Alternate activity for the spouse in the Armstrong Room.

7:00 pm—Awards Banquet. Requires banquet registration.

9:00 pm—Post Banquet, chat session, Bring QSLs to exchange! (Ballroom).

Sunday May 16th

Hamvention and home.

FDIM Hotel Information and Room Reservations

Rooms at the Dayton/Fairborn Holiday Inn are $110/night
E-mail room request to: QRPRooms@qrparci.org

Vendor Night / Sponsorship Opportunities

Vendors! Register online at www.fdim.qrparci.org
Or, contact Norm, WA4ZXV, at: norman@schklar.com

FDIM 2010 Registration Form

Registration is available on-line at http://www.fdim.qrparci.org (preferred method).
This form is provided for those instances where on-line registration is inconvenient.

1. Fill in the form
2. Mail Payment to: Jack Nelson, 1540 Stonehaven, Cumming, GA 30040 USA
   Make check payable to: QRP ARCI

PLEASE PRINT LEGIBLY (Your Badge will reflect your writing)

Your Name: First or Given ________ Last or Family ________

Callsign: ____________________________

Email: ____________________________

Telephone: ____________________________

Seminar QTY __ @$40 = $ _______

Banquet QTY __ @$35 = $ _______

Buildathon QTY __ @$30 = $ _______

Amount Included(includes additional below): $ _______

Day of arrival | Wednesday | Thursday | Friday | Saturday | Don't Know (circle one)

Plan to Stay at | Holiday Inn | Other (circle one)- For hotel reservations please visit rooms.qrparci.org

Do you plan to enter an item in: | Show and Tell |Homebrew| (circle as necessary)

Payment is included with form ☐ (Please check the appropriate box)

Your First FDIM? ☐

Ok to contact me to help at FDIM ☐

Please help with our planning by completing these items.

I plan to participate in the Show and Tell ☐

I plan to participate in the Homebrew Contest ☐

I am interested in spouse activities ☐

Additional Registrants ☐

Name	Callsign or Guest/XYL	Seminar $40.00	Banquet $35.00	Buildathon $30.00
Name: First or Given ________ Last or Family ________		☐	☐	☐
Name: First or Given ________ Last or Family ________		☐	☐	☐
Name: First or Given ________ Last or Family ________		☐	☐	☐

For the latest FDIM information, please visit http://www.fdim.qrparci.org

Questions, please contact Norm, WA4ZXV at fdim@qrparci.org

(photocopy this form to avoid damaging the magazine)

Making a Sofware Defined Radio for the QRP Enthusiast: Part 1

Ward Harriman—AE6TY ae6ty@arrl.net

I am a relative newcomer to the world of amateur radio. I first became interested several years ago while casting about for a hobby to enjoy in my retirement. In my explorations, I found myself repeatedly drawn to various radio related topics and kept coming across publications by the ARRL. After repeated exposure, I found myself studying up for my license and even learning Code. I was hooked. Even more unexpected, I started to be intrigued with building my own rig. The primary reason for this desire was simple, I wanted to be able to say "rig here is homebrew" during my QSOs. And "homebrew" to me meant homebrew design, homebrew assembly, homebrew programming, homebrew in a wide range of disciplines both familiar and untried. AND: the rig had to work well enough to actually MAKE QSOs.

This article will describe the resulting rig, but even more importantly it will also describe some of the skills I had to pick up along the way and the reasoning I used to make design decisions. It is my hope that those readers who are newcomers to the homebrew art, or at least not practiced aficionados, will be encouraged to expand their skills and take on some new adventures in homebrewing. For those interested in replicating all or part of this project, the QRP ARCI website will have more detailed construction information to include schematics, software listings, and PC board designs.

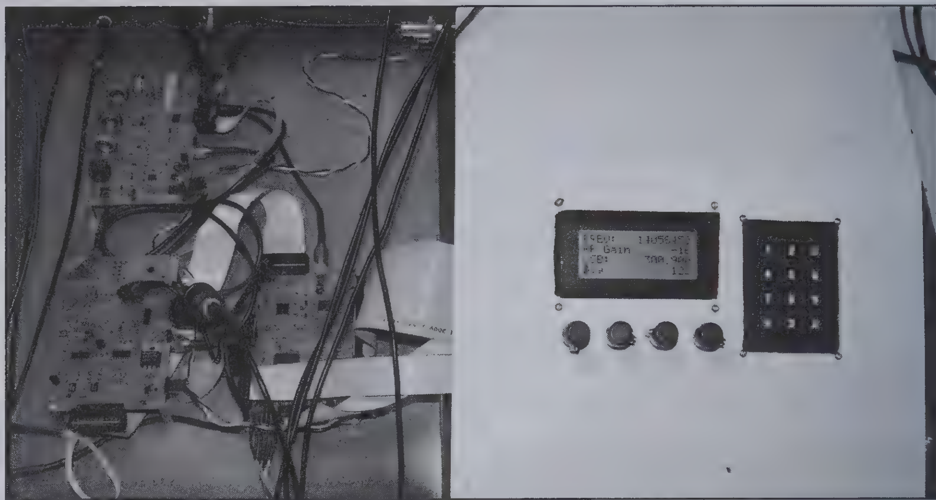


Figure 1—The SDR Transceiver, with case in the open position.

The Quandary

There were two areas in amateur radio which intrigued me: QRP and Software Defined Radios. In many ways, these two facets of radio are polar opposites.

At one extreme is QRP. Now strictly speaking, QRP means reduced transmit power but in fact the QRP community is also concerned with homebrewing, low power consumption and (often) portable operations. QRP also often implies a certain frugality: doing more with less. One popular QRP radio, the PIXIE II has only two transistors and a single audio amplifier IC! With this discovery, the idea of designing and building my own rig started stirring in the back of my mind.

At the other extreme is Software Defined Radios. The most common implementation of an SDR starts with a small piece of hardware usually described as a down converter which translates the RF signal "down" to audio frequency signals. Once this conversion is done, the majority of radio functionality can be implemented in software running on a personal computer. These down converters can be quite simple; a state of the art down converter requires no more than a few ICs and a handful of discrete components. Most of the rest of an SDR usually resides in a personal computer, which is both the good news and the bad news so far as QRP is concerned. The good news is that Software Defined Radio has become quite inexpensive because it leverages the consumer Personal Computer market. It uses inexpensive processors and high quality sound cards to provide nearly all the hardware necessary to implement a Software Defined Radio. But while providing extremely high performance radios, the PC-based SDR has some significant shortcomings. Even the most frugal laptop PC costs hundreds of dollars, weighs in at several pounds and uses tens of watts. Further, the typical laptop PC is not tolerant of dirt and moisture and is difficult to operate in sunlight. For the QRP enthusiast who embraces low power consumption and portable operation, today's Software Defined Radio has some very serious drawbacks.

Hence, an impasse: how can one explore the world of Software Define Radio within the value structure of the QRP community? It became clear that the major obstacle to QRP style SDR was the presence of a full-blown PC with its attendant disk, LCD screen and full sized keyboard. The goal, then, was to provide a low cost alternative to the PC which was at the heart of most SDR projects.

The Solution

It became clear to me that in order to "do it myself" I would have to get rid of the PC and replace it with a small, low power digital signal processor (DSP). The DSP would be programmed largely from scratch. For example, there would be no need for a "Signal Processing Library"; the goal was to write one. Further, there would be no need for an Operating System; the processor was to be dedicated to the application. There would be no file system needed and there were no standard peripherals to be controlled.

Although I have been involved with electronics for quite some time, this project was really my first run at radio frequency design. Therefore, a primary consideration was to provide a learning platform for both RF design and for SDR technology. Thus, modularity was a primary goal; changing one portion of the circuitry should not require replacement of unrelated portions. Also, it was important to provide easy access to the circuits themselves for prob-

ing and rework. Multiband operation was desirable but not an overriding concern. Since this was a "Software Defined Radio" project, software was to be the largest fraction of effort and so providing a good software development environment was paramount; a high level language "Integrated Development Environment" was essential.

There were, as usual, several "non-goals" for this version of the transceiver. It was not a goal to minimize power consumption. It was not a goal to provide portable operation. It was not a goal to maximize RF performance; for example, no shielding was to be provided. It was not a goal to minimize circuitry or cost. All of these non-goals could be realized in later versions of the transceiver, incorporating the lessons learned from this first exercise.

Figure 1 shows the rig prepared to provide the three basic functions: on the air operation, circuitry debug and software development. In normal operation, the cabinet is assembled and only the display and controls shown on the face of the cabinet are visible. However, the transceiver will operate as shown. Generally the enclosure is buttoned up even when doing software development, mainly to free up bench space.

As can be seen in Figure 1, beauty in packaging was not a primary goal. Leaving lots of room to allow easy access to the various boards was a primary requirement. Indeed, the entire rig can be removed from the enclosure and placed directly on the workbench. When working on a new board, the board can be placed on the bench and stitched in using long cables. Circuit debug almost never takes place inside the enclosure. Originally it was assumed that a backplane of some type would be used to connect and support the boards. This may prove desirable in the future but for now simple ribbon cables work well and provide more flexibility.

In operation, the rig is controlled by the four multifunction knobs and the numeric keypad on the front panel. The leftmost knob controls the parameter listed on the top line of the display. The second knob from the left controls the parameter listed on the second line of the display, and so forth. Control parameters are chosen from a menu by scrolling through the menu using the keypad. Pushing the 4 button moves up the menu, pushing the 6 button moves down. By hitting the # key, the keypad can be used to enter a parameter value directly. This is particularly useful when entering frequency. Parameters and functions that can be controlled from the front panel include:

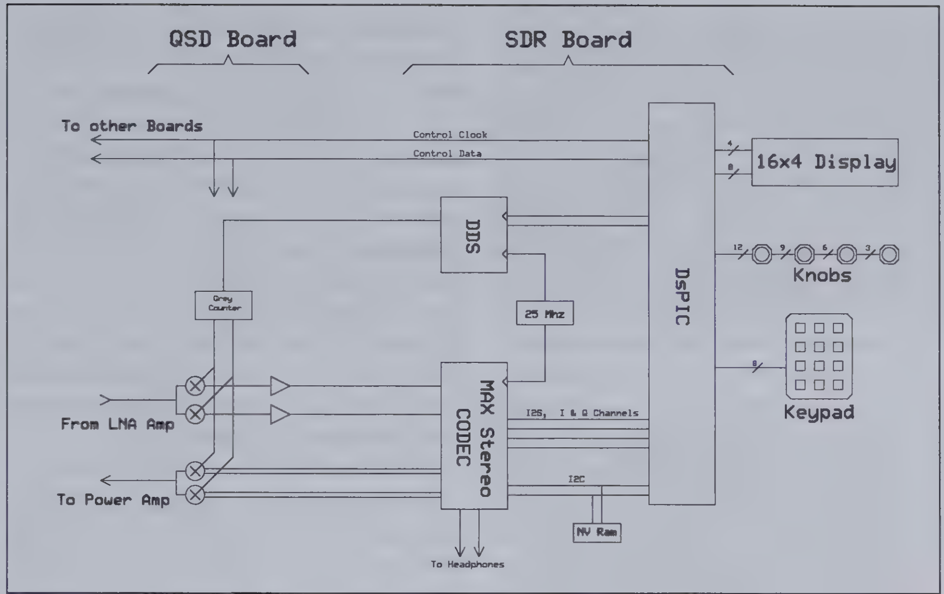


Figure 2—Hardware block diagram for the transceiver.

a. Frequency
b. RF Gain (gain between QSD and the A/D converter inside the CODEC)
c. AF Gain (gain from D/A of CODEC to the headphones)
d. Mode (USB, LSB, BOTH, Binaural)
e. Receive bandwidth
f. Receive Bandwidth Filter Length
g. Delay (delay data to right ear by this amount)
h. Sidetone Volume
i. Sidetone frequency
j. Words Per Minute (CW Transmit speed)
k. Analog front end gain adjust
l. Analog front end phase adjust
m. RF Receive Level (monitor only, essentially an S meter)
n. Interrupt instruction count (# instructions executed for each CODEC sample)

The list of parameters is continuously in flux as features are added or removed. Because of this, it is essential that any SDR project provide a mechanism to easily add and control parameters.

Figure 2 shows a hardware block diagram for the transceiver. Signals come into the transceiver through a band-specific low noise amplifier (not shown), through the receive quadrature sampling detector (QSD) and into the CODEC (coder/decoder) where they are digitized and sent to the embedded microprocessor. Likewise, transmitted signals go through the CODEC where they are converted to analog format and sent to the QSD board for up-conversion to the transmit frequency. From there, signals go to a broadband driver amplifier (not shown) located on the QSD board and on to a band-specific 5 watt Class E power amplifier. The band-specific components for each band, namely the low noise receiving amplifier and power amplifier, are located on single boards that can be stacked on top of each other. Switching controlled by the microprocessor selects the appropriate board. In Figure 1, a single band-specific board appears in the upper left corner. At present, boards have been constructed for 40, 30 and 20 meters.

Making Choices

Probably the most fundamental choice one makes in designing a radio is the basic architecture. Does one build a superhet? How about a Direct Conversion? Does one use phasing techniques or narrow filters for sideband rejection? These and many other questions continued to circle the subconscious for several months. In the end, the decision was made to use phasing techniques to create I and Q signals at baseband. The I/Q signals would be digitized by an A-D converter and processed by the processor. The processor would provide

filtering and side channel suppression and deliver an audio signal to the user.

At the heart of the SDR is the processor itself. The most significant criterion for choosing a processor was that it be mountable by a hobbyist with moderate skill and determination. Hence, ball grid arrays and even packages numbering hundreds of pins would present problems. Second, the chosen processor must require modest initial investment and be easy to program using a high level language. An in-circuit debugger was mandatory. Third, the processor would need to be low power; a power budget on the order of a watt seemed reasonable. Finally, it would need to connect to the A/D and D/A converters of choice as well as switches and displays.

Ultimately, the processor chosen was the dsPIC33F256 from Microchip. In many ways, the dsPIC product line is underpowered compared to modern DSP processors from vendors like Analog Devices and Texas Instruments. Still, the dsPIC has much to offer: it is low cost, low power, and comes in convenient packages. The development environment (called an Integrated Development Environment or IDE) runs on a PC and is the right price (free). The single upfront cost for using the dsPIC line was a small investment in an "In-Circuit Debugger." This will be discussed later in the sections covering software development.

Once the processor had been chosen the next step was to identify a viable A/D and D/A converter, or CODEC. Because the dsPIC is a 16 bit processor, a 16 bit CODEC seemed to be the best choice. It is well known that more bits in the CODEC translates directly to better dynamic range but it was decided that 16 bits would probably be adequate for this project.

The range of CODECs is just as large as the range of DSPs. Ultimately, the MAXIM MAX9851 stereo CODEC was chosen. A block diagram of this part is shown in Figure 4. The target market for this CODEC is cell phones and MP3 players. The only significant drawback of this device was that the packaging was a little scary. Still, what project is complete without at least a little fear?

Having chosen a processor and CODEC it was time to choose the implementation of the down converter. Fortunately for the newcomer, there are many fewer choices available. This area was completely unfamiliar, so exploratory prototyping was done. Using ugly construction, several different mixers including a multiplexer based commutating mixer, a high level diode mixer (TUF3) and a FET based H-mode mixer were prototyped. Ultimately, a variation of the Quadrature Sampling Detector was chosen. This circuit has been popularized by Dan Tayloe (N7VE) and is the basis of the popular "Softrock" series of down converters. There are numerous examples of this circuit in the public domain and so this circuit is not discussed further here.

Once a down converter was chosen it was necessary to choose a VFO technology. After a variety of experiments, the Analog Devices AD9951 Direct Digital Synthesis chip was chosen. This circuitry for this subsystem was lifted almost exactly from the application notes provided by Analog Devices and is not discussed further here.

Getting Started on Hardware Design

A great deal of construction in this wonderful hobby can be done using "ugly" construction. Indeed, the author did a great deal of prototyping of the various circuits from EMRFD. However, it was all too clear that the dsPIC processor and the MAX9851 CODEC would require the development of a printed circuit (PC) board. Further, the number and spacing of pins on the IC's to be used implied that any of the homebrew techniques for making PC boards would not be adequate. After spending several evenings in ugly construction, this author has come to consider the cost of a PC board a good investment. The level of frustration is much reduced and the pride in craftsmanship is much enhanced. Thus, it was decided to use PC boards for all the circuitry.

A little research on the web led to the discovery of several companies offering custom PC board fabrication. During this research a few essential features were identified. The first essential feature was the ability to manufacture standard industry boards: .064 inch thick, fiberglass, plated through holes, minimal etch width of 6 to 7 mils (thousands of an inch), 1/2-ounce copper and tinned. The second essential feature was that the PC board vendor supply or directly support a complete tool suite. The tool suite should provide three basic functions integrated into a single, seamless design and fabrication process. These are "schematic capture," "pc board layout" and "fabrication" including ordering, payment and delivery.

The schematic capture tools must provide a library of common components and the ability to add user defined components. Further, it must support multi-page schematics and provide minimal "design rules checking" to help ensure a well-defined design. Finally, the schematic capture tool should provide a parts list and a net list for use by the printed circuit board layout tools.

The printed circuit board tools should use the netlist provided by the schematic capture system to help ensure proper connectivity during the pc board layout process. Navigation around the design (panning, zooming, selection, searching, library commands, etc) should have the same "look and feel" as the schematic capture software. There should be no need to learn a new set of commands for these basic operations.

The pc board layout tools should provide for "power planes." When a signal is run on a power plane, the tools should provide spacing around the signal automatically. Additionally, the tools should provide thermal relief of pins connected to a power plane. Support for arbitrary shapes of power planes is highly desirable.

As with the schematic capture tools, the p.c. layout tools should provide an extensive library and allow the designer to easily add components as desired. Building a new component should be straightforward and take only a few minutes to create a typical footprint.

The p.c. layout tools should support common layout techniques such as "rats nests" and component rotation. It must be easy to lay down and modify etch. Changing etch width should be simple and moving an etch from one layer to another should result in automatic via generation.

Once the design is complete, the ordering and fabrication should be a simple matter of submitting a design file and paying with a credit card. The design should be conveyed through the internet. The vendor should enforce any "design rules" (board size, etch widths, hole sizes, spacing, etc) that are necessary to ensure proper fabrication. There should not be the possibility that a submitted design is "unmanufacturable."

In the end, several companies met all the above requirements. Ultimately, a company called "ExpressPCB" was chosen, in part because of their "miniboard" service. A miniboard is a 2.5 × 3.8 inch, two-layer board made of FR4 fiberglass. It allows etches down to 6 mils and via holes down to .014 inches. A maximum hole count of 350 is enforced. This miniboard service does not provide a silkscreen or solder mask; things often considered luxuries by the homebrew community. Once a design is complete, ExpressPCB can fabricate and deliver 3 copies of the board for $51 plus shipping. More information can be found at www.ExpressPCB.com.

This author was familiar with the principles of p.c. board layout and so it took only a couple of evenings to be comfortable with the tool suite. Of course, as with any tool, the more it is used the more productive one becomes. Complete mastery probably takes three or four projects. Those unfamiliar with p.c. layout techniques can often locate an introductory course at a nearby community college or hobby center.

When a p.c. board is designed the result is called "artwork" and for good reason; the design of a p.c. board is indeed a work of art. Through experience, each designer develops a "style" that often becomes almost a religion. For this author, all designs have several things in common:

- All designs use the same board outline and mounting hole placement.
- All designs are two layers and have the bottom layer as ground.
- All bypass capacitors are on the bottom layer
- All non-RF connectors are .025 inch posts on .1 inch centers
- All power entering the board is polarity protected with diodes.
- All connectors are through hole to provide strain relief.
- All ICs are surface mount whenever possible.
- All passive components (except bypass caps) are SMD-1206 whenever possible.
- All traces are run on the top layer except when absolutely necessary (the ground plane is kept as intact as possible).
- All power is 'locally' regulated.
- Signal etches are as wide as possible and spaced as far apart as possible.
- All designs have multiple "ground posts"; places to connect a ground clip.
- All through holes are larger than absolutely necessary as this simplifies rework considerably.

There is much to be said for making the design "pretty," for "pretty" often translates to "working." Take advantage of the flexible pinouts of modern ICs; choose convenient pinouts to simplify PC board layout. Spending time on the layout allows the subconscious to think about the design and find problems. It is very common to discover a circuit design flaw during layout.

The First Subsystem

Having chosen to use printed circuit boards and chosen a tool suite, the actual design and construction of the various modules could begin. The first project was the QSD down converter board. It is simpler than the others and less dense. The schematic was drawn up and checked several times. Then, the two layer PC board was laid out. The ExpressPCB tools provide a way to check your schematics against the actual PC board layout. After confirming the actual layout matched the schematic, the design was almost ready for fabrication; "almost" because there is one more crucial step…

Once the p.c. board is designed, one should print out all board layers at a 1/1 scale. Since the board is two layers, the top layer is printed in red on an overhead transparency and the bottom layer is printed in green on ordinary paper. This approach allows both layers to be examined at the same time. Using the printed etch as a template, each and every component is placed on the transparency to make sure the leads were properly spaced and no component interfered with any others. Alternatively, a part can be laid on its back and the transparency laid on top. This approach was used for the CODEC chip.

Even though the design was extremely simple, several parts were moved to simplify assembly and testing. After doing this mechanical check several times, the design stabilized and it was submitted to ExpressPCB for fabrication. Three days later the board arrived and, as usual, the fabrication was flawless. Assembly was uneventful.

As an aside, some of the extra room on the down converter board was used to place a footprint for the CODEC chip which was to be used on the SDR digital board. This allowed me to practice mounting the CODEC.

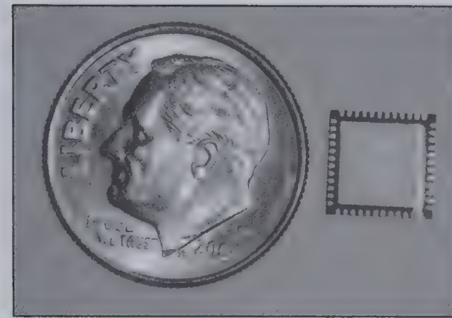


Figure 3—Bottom side of the CODEC.

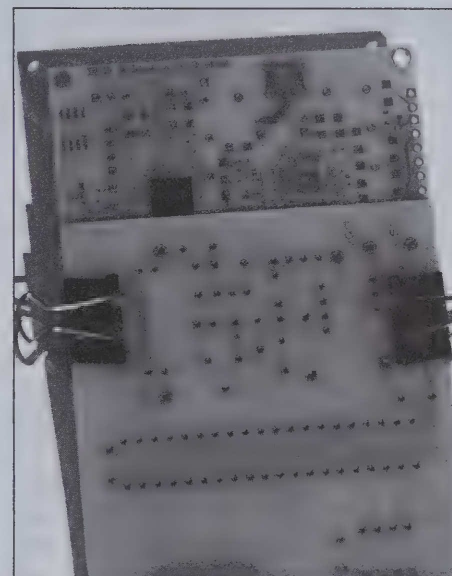


Figure 4—Holding the CODEC in place.

Surface Mount Components

Having completed the down converter section of the SDR it was time to start working on the unique part of this SDR project: the digital module. The first step in this effort was to ensure that it was possible to mount the CODEC onto a p.c. board of home design using home methods. Figure 3 shows the bottom side of the CODEC. It is very difficult to see the pads involved much less believe one can actually solder them to a p.c. board using homebrew techniques. So, one of the spare QSD boards was sacrificed to experimentation.

A great deal of experimentation followed but the final approach turned out to be simplicity itself. After a little introspection, it was realized that the biggest problem was getting the chip aligned and held in place long enough to solder it down.

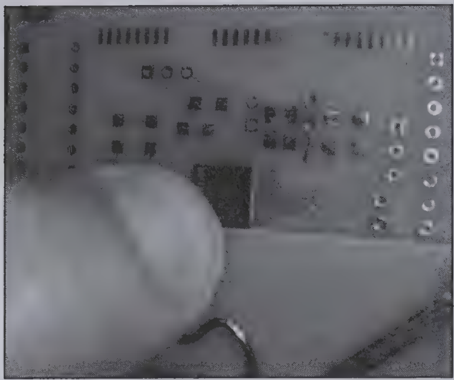


Figure 5—CODEC ready for soldering.

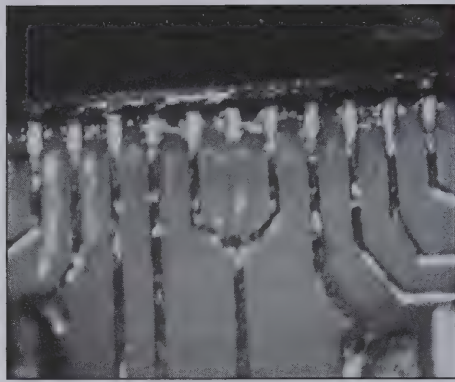


Figure 6—CODEC after soldering.

Here's one way it can be done: First, using a couple of report clips, a scrap piece of p.c. board was attached to the target board. Figure 4 shows how this is done. Because the boards are rectangular, the rotational alignment of the two PC boards is trivial. While the two report clips hold the board together snugly, it is still possible to move one up and down. Movements as small as a few thousands of an inch are easily controlled. The CODEC chip is lightly pushed against the "alignment" board. Thus, with minimal effort the CODEC chip can be aligned longitudinally and rotationally.

Using a pair of jeweler's glasses simplifies the alignment of the CODEC along the edge of the alignment board. Again, this turns out to be a relatively simple exercise. The CODEC is easily held in place with a single hand. Figure 5 shows the CODEC in place ready to solder.

The actual soldering also turned out to be rather simple. A small amount of solder paste was purchased at a local electronics store and a small syringe at a craft store. To make the solder paste flow more evenly it was cut with a few drops of rubbing alcohol. While holding the chip in place with a thumb, a small amount of solder paste was applied to one corner of the chip. With the chip aligned and the solder paste touching the actual pad and trace, a brief touch with a fine point soldering iron applied the necessary heat. The solder paste immediately melted and flowed directly to where it was needed… one corner was attached.

Once the chip was held firmly in place it was possible to remove the clips and alignment p.c. card. The alignment of the chip is examined on all sides. If alignment is not good enough, a little hot air or a glob of solder could be used to de-solder the part. After using some solder wick (dipped in flux) to remove any extra solder on the chip and p.c. board another attempt could be made.

Once the chip alignment was ensured, the next step was to solder the rest of the pads. This can be done by running a very small bead of solder paste down the edge of the chip. Then, using a very fine tip on a normal soldering iron, the paste was melted. Although it sounds cliché, solder really does want to go to the right places. This technique ALWAYS delivers solder between the chip pads and the PC etches; the solder wicks into the tiny spaces where it is needed. The only problem, unfortunately, is that even with solder paste which has been thinned extensively, too much solder is delivered and there will be shorts between the PC etches. However, solder being what it is, it a little flux and a very fine piece of solder wick quickly and easily removes the excess solder. Repeat this procedure on the other three sides and VOILA!!

Like many other skills, this process took a little practice. Ultimately the CODEC could be placed quickly and reliably. Figure 6 shows the result of this soldering approach before the rosin was cleaned away.

The SDR Digital Subsystem

Having developed a technique to successfully mount the CODEC it was time to start the design of the digital part of the SDR. SDR software can be divided into two pieces: the control plane and the data path. The control plane is used for both human interface and for control of the CODEC. The data path is used for manipulation and forwarding of signal-related data. The original thinking was to use two independent processors, one for each path, connected using some kind of serial link. While this may ultimately prove necessary, the present implementation uses a single processor to implement both subsystems.

Even though the processor DDS and CODEC had already been chosen, there remained numerous, less critical decisions. For example, the majority of digital logic these days runs on 3.3 volts (or lower) and the CODEC and DDS run on 2.5 and 1.8 volts respectively. How should one provide these lower voltages? One could use simple linear voltage regulators but these would be very inefficient; less than 20%. Alternatively, DC/DC converters could be used which would be better than 90% efficient but be more expensive and require significantly more design work. The decision was made to use a DC/DC converter (a Linear part) for digital voltages and "Low DropOut" (LDO) linear regulators for the lower and more critical voltages. This approach has worked extremely well and is highly recommended. The LDO linear regulators are very small and can be placed immediately beside the component using the power.

Another secondary decision was how much non-volatile memory to provide. This memory would be used to store calibration parameters and perhaps short CW messages. Most of the Microchip PIC processors provide some small amount of non-volatile memory. Unfortunately, Microchip decided not to include any non-volatile memory with the particular processor chosen. Consequently, it was necessary to include a small flash memory; "small" meaning 8 pins and 256k bytes.

A third decision was what kind of display to provide. One my main complaints with most modest radio designs is the limited display capability. With this in mind a 16×4 alphanumeric character LCD was chosen. Should this prove overkill, future implementations could use a smaller display. As an interesting aside, this display consumes considerable power and some form of power management will ultimately be necessary.

Another substantial decision to be made was choosing the input method for controls. There are several choices, buttons, knobs, keypads, etc. The first attempt at providing a user interface was a failure; this is not the place to be frugal. In the present design there are four knobs, one for

each line of text. There is also a 12 key keypad for direct entry of parameters such as frequency. Even this proves to be inadequate and more knobs will probably be introduced in any future design.

The Digital Circuit Design

Having chosen the processor, the CODEC, the DDS, the display, the switches, knobs and oscillator; the time had come to do the detailed design, using the basic block diagram of Figure 2. The block diagram demonstrates the simplicity of the digital piece of this SDR: there are really only three significant digital-oriented blocks: the DDS, the CODEC and the dsPIC.

These three blocks are connected by relatively few signals: the I2S and the I2C busses connect the dsPIC and CODEC, and a simple two-wire interface connects the dsPIC to the DDS. The I2S (which stands for Intra-IC Sound) conveys the 16 bit A/D and D/A information. The CODEC is the master of this interface because it provides the clock and framing signal. Two samples in each direction are conveyed at up to 48 kHz when the oscillator runs at 26 MHz. Thus the SPI clock itself runs at roughly 1.5 Mbits/second. However, a 25 MHz oscillator was available from previous projects and substituted for the specified 26 MHz. Other than the attendant reduction in sample rate, no adverse affects have been discovered.

The I2C (which stands for Inter Integrated Circuit) is a low speed bus which runs at several hundred kilobits/second. It is used to initialize the CODEC and to control the gain of the various CODEC amplifiers. In addition, the I2C bus is used to communicate with the flash memory chip to store and retrieve configuration data.

The display module is a Hantronix HDM16416L, LCD display. The connection to this part is directly from the manual. Not shown is a simple transistor switch which controls the LED backlight of the display. This LED is extremely power hungry and an operator specified timer is used to disable the LED a short time after any display update.

The keypad and knobs are the usual culprits. A background software routine polls for switch closures. Turning a knob causes events to occur so fast that interrupts are necessary to reliably track knob turns. The dsPIC provides hardware for generating "interrupt on change" and the knob signals were run directly to dsPIC pins with no external logic required.

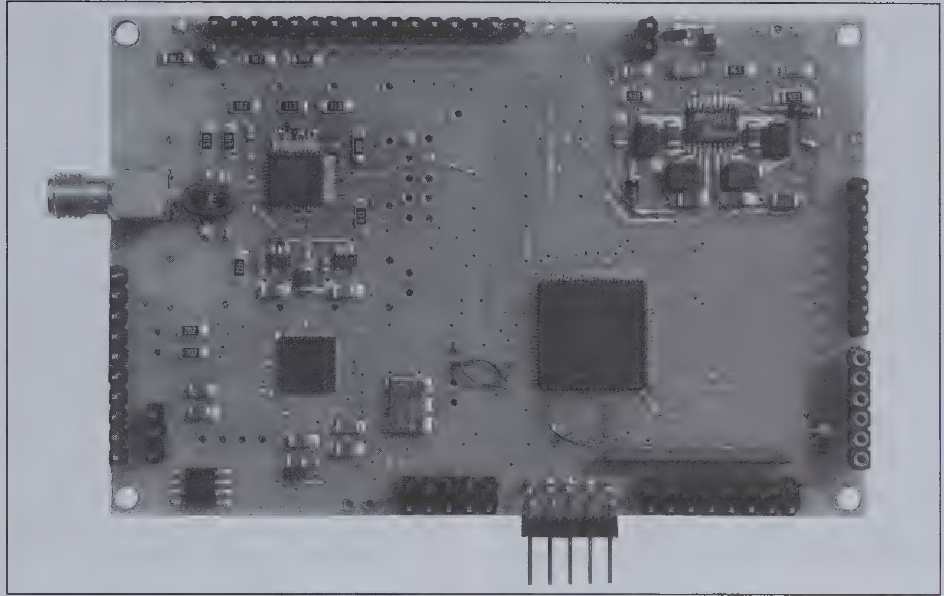


Figure 7—SDR Processor Board at completion.

In reality, the digital hardware portion of this SDR project is extremely straight forward and represents no significant challenges. There are no particularly high speed signals and the dsPIC and CODEC follow the standards well. The design really was simplicity itself. Hooking up the various parts as specified by the manufacturers delivered a solid and functional subsystem which operated exactly as expected.

Digital Circuit Layout

The layout of the SDR processor board pushed the limits of both designer and tool. The layout went through several iterations, during which the best pinouts of the dsPIC were chosen and the best connector layout was reached.

Once the final placement of the ICs and connectors was chosen, the layout of the signal etches was a long but straightforward effort. The layout of the SDR board took several nights working into the wee hours of the morning. After verifying the pinouts and IC footprints, the SDR digital board was ordered.

As always, PCB fabrication was flawless. Assembly of the board was time consuming but uneventful. Power was applied and a few design errors were discovered; notice the wires on the board in Figure 7. All in all, careful layout and almost obsessive checking of every detail yielded a workable board the first time out.

Remaining Development

At this point, the entire hardware portion of my SDR has been discussed with the exception of the band-specific boards. These boards each contain a low noise preamplifier and a 5 watt transmitting amplifier tuned to the band in question. This amplifier operates in Class E and will be considered in a separate part of this article series to allow more discussion of design principles and methods.

The other remaining development is, of course, the software used in this project. Since it is the heart of an SDR, it too deserves a separate article of its own. This article will discuss the methods of software development used as well as the actual software itself and the functions it provides.

Watch for these two articles in future editions of QRP Quarterly.

Personal Retrospection

At the end of so large an effort it is probably a good idea to sit back and think about what might have been done differently. The word "MIGHT" is important here. The whole project was conceived as a learning vehicle and, as such, it succeeded beyond my expectations. In fact, this transceiver has become my main rig and is used on a daily basis. Still, here are a few ideas:

First, while the dsPIC is a perfectly fine processor, a true DSP from TI or Analog

Devices might be a better choice. These manufacturers continue to advance their offerings while Microchip has largely abandoned the dsPIC line. Further, a floating point DSP might be a good idea as well. Alternatively, the design of the SDR board could be entirely avoided: there are now small DSP evaluation boards which are very inexpensive and quite functional. Connecting one of these boards to a complete user interface may be problematic.

Second, the decision to design the down converter could have been avoided and a commercial version used. For example, a SoftRock40 or SoftRock20 could have been substituted.

Third, a DDS may not be the easiest way to provide the VFO functionality. A new technology called a "silicon oscillator" is becoming mainstream. A good example is the SI570 from Silicon Labs. This part is attractive because it is easier to mount than most DDS chips and provides a square wave output which can be connected directly to logic. Further, unlike most DDS ICs, the silicon oscillators do not need an anti-aliasing output filter.

Enough second guessing. Here are a few important lessons learned:

First and foremost—the user interface is NOT incidental to the design of a radio. Yes, there are countless rigs which have only a few knobs and no readouts. While these rigs can be effective and fun, this author finds them to be frustrating when used for long periods. Indeed, more knobs are better and more display is better. Any future effort will certainly increase the number of knobs and provide a larger keypad.

Second—one should use components which have solid documentation and IF AT ALL POSSIBLE have an evaluation board with a published schematic. There's no reason to purchase the evaluation board but there is good reason to believe the schematic will work if the manufacturer offers an evaluation board.

Third—local power regulation is a small expense with huge payoff. Small DC/DC converters work well and are all but required by the low voltages of modern, large scale ICs. Analog power supplies should use small linear regulators placed immediately beside the ICs using them. Don't share analog supplies between devices. ALWAYS POLARITY-PROTECT EVERY BOARD'S POWER IN….. ALWAYS! A 10 cent diode can prevent hours of rework. A couple seconds of thoughtlessness can be very costly.

Fourth—most manufacturers provide samples; one or two are usually free. Even relatively large and expensive ICs are often sampled. All the voltage regulators used, the CODEC and the op amps were all samples in this project.

Also, however tempted, don't crowd things. Packing things close together complicates every aspect of the project. Leave size optimizations for rev 2 or even 3!

Oh, get comfortable with surface mount parts. Nearly every modern IC is surface mount and relying on old through-hole parts is too restrictive. Never fear, if you can see the pins, even with jeweler's glasses, you can solder it down.

Final Note

Here is the most important lesson learned: If you have a project in mind, don't shy away from it. It is a timeless cliché but it is true, nothing teaches like doing! ●●

Easier and Better Circuit Construction with Circuit Stickers

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Circuits are built using various construction techniques [1]. The easiest circuits to build use a printed circuit board with a component legend printed on the board. The component legend shows outlines of the components and the holes or pads to which they attach. Each component outline has a reference designator such as R1, U3, C4, etc. that clearly indicates which component from a parts list goes in the outline. All you do is solder the components to the board where the component legend shows and in the orientation that the legend shows.

Other construction techniques are necessary because a printed circuit board isn't available or it costs too much or there isn't time to make one. These other construction techniques using perf boards, solderless breadboards, bare copper PCB material, and homemade printed circuit boards are more difficult because the component legend is missing. Repairs are also more difficult with the other techniques because of the missing component legend. The wiring of components in techniques that don't use a printed circuit board is error prone because there's nothing on the board that shows the wiring. You have to check the board with a schematic or wiring diagram to make sure it's wired correctly.

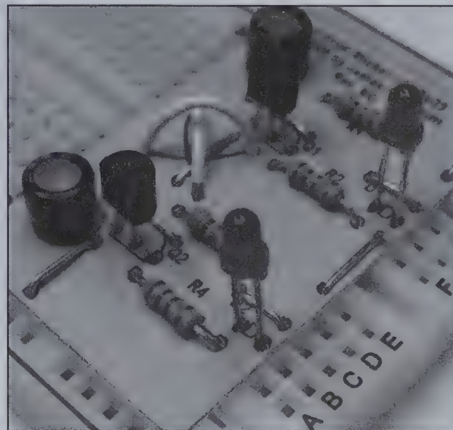

Figure 1—CSBL03 LED blinker Circuit Sticker

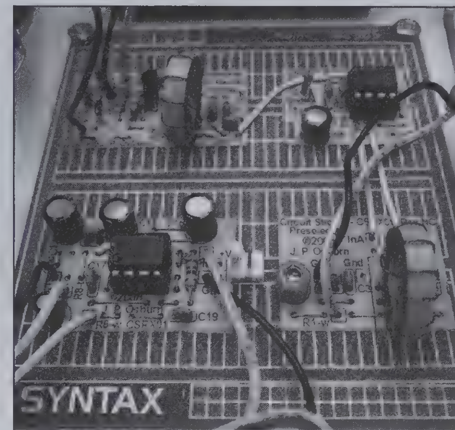

Figure 2—CSRX01 20 Meter band DC Circuit Sticker receiver

What is a Circuit Sticker

Something that mitigates these problems with the other construction techniques is a Circuit Sticker—a label with an adhesive backing that's stuck to the circuit board. The circuit board can be any type of board including perf boards, solderless breadboards, bare copper PCB material, or homemade printed circuit boards but the Circuit Sticker is typical designed for just one type. The Circuit Sticker provides the component legend that's normally missing with the construction techniques that use those types of boards. It also shows the wiring of the components in techniques that don't use printed circuit boards that have all the wiring and component interconnections fabricated into the board.

Not A New Idea

From 1958 until 1972 the magazine *Electronics Illustrated* was published [2]. It featured many interesting electronic construction articles. Frequently there was a wiring diagram printed with an article that was intended to be copied or redrawn and then pasted or taped to a wood board. Finishing nails were then driven into the board at connection points indicated in the wiring diagram by a dot. Components and wires were then soldered to the finishing nails to complete the circuit [3]. This made it almost fool-proof to build a circuit. Circuit Stickers are the same concept although using smaller components on different kinds of circuit board.

Example Circuit Stickers (and Designing, Making and Using Circuit Stickers)

To demonstrate what circuits can be built using Circuit Stickers this article will show 6 examples: an LED blinker circuit, a 20 meter band receiver, a CTCSS tone encoder board, a CW memory keyer and trainer, a CW computer interface, and a 40 meter band receiver. Some of these circuits are available as kits from my web site at http://www.indianakits.com. All of the Circuit Stickers themselves are available for purchase on my web site. This article will also discuss how Circuit Stickers are designed, made and used.

LED Blinkers

The beauty of a LED blinker circuit is it's a fairly simple but nontrivial circuit that gives a straightforward indication that it's working. Either it blinks or it doesn't. The LED blinker is an astable multivibrator [4] comprising 2 transistors, 2 LEDs, 4 resistors and 2 capacitors. When it's working properly the 2 LEDs alternately flash on and off. A picture of an LED blinker built on a solderless breadboard using a Circuit Sticker is in Figure 1. Power to the circuit comes via the positive bus that runs across the top of the solderless breadboard and the negative bus that runs across the bottom. The LED blinker will run on just about any voltage from 3 volts to 12 volts and higher.

20 Meter Band Receiver

As QRP Amateur Radio Operators we're interested in building receivers, transmitters, transceivers, etc. Circuit Stickers are also useful for that but solderless breadboards aren't suitable for RF circuits. An acceptable alternative is perf board. The Neophyte/Sudden/EMRFD [5, 6, 7] type of direct conversion receiver based on the NE602 mixer/oscillator and the LM386 audio amplifier performs well and can easily fit on one perf board. A picture of a direct conversion receiver for the 20 meter band using Circuit Stickers on perf board appears in Figure 2. The receiver is built in a plastic tray so it can be easily displayed. Normally such a circuit would be built in an enclosure.

The receiver covers the entire 20 meter band and has band-set and band-spread tuning knobs. There's also RF and AF gain

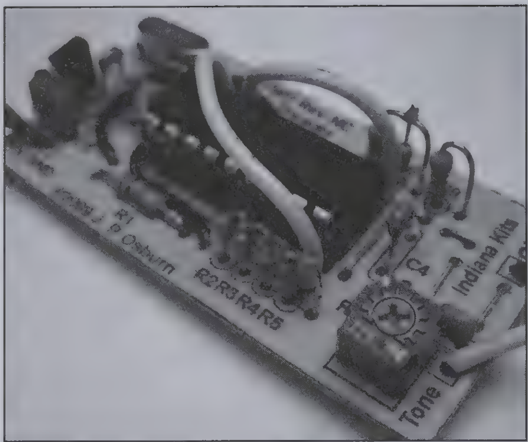

Figure 3—CTCSS sub-audible tone encoder Circuit Sticker board.

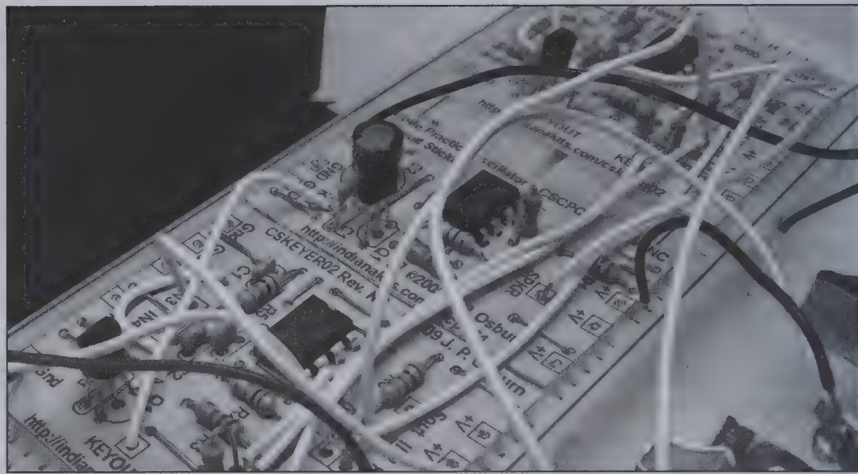

Figure 4—PICAXE bsed memory keyer Circuit Sticker circuit.

controls. There's a BNC connector for the antenna. The little LM386 can drive the typical 32 ohm audio player headphones. The receiver operates from 4 AA cells in the battery box. There's an on/off switch on the battery box.

There are 4 Circuit Stickers used in the receiver in Figure 2. The Circuit Sticker in the upper left corner is the tuning for the local oscillator. The Circuit Sticker in the upper right is the NE602 mixer/oscillator. The Circuit Sticker in the lower right is the pre-selector and the Circuit Sticker in the lower left is the LM386 audio amplifier.

Tone Encoder

A CTCSS sub-audible tone encoder [8] Circuit Sticker board is shown in Figure 3. It's built on perf board and the board is trimmed to be the same size as the Circuit Sticker. It's based on the PIC16F54 microcontroller from Microchip. The microcontroller clock is controlled by a 20 MHz crystal so the sub-audible tones generated will have the correct frequency. Resistors are used to form a 6-bit A-to-D converter to generate a sine wave. A LM78L05 3 terminal voltage regulator is used to allow the circuit to be powered from a DC power source from 7 volts to 18 volts. The board is perhaps a bit large to be mounted in an old HT but old mobile rigs tend to have enough room. More detailed information and the source code for the microcontroller is available on my web site at http://www.indianakits.com/cstn01/.

Memory Keyer and CW Trainer

A picture of a memory keyer based on the popular PICAXE-08M [9] microcontroller appears in Figure 4. The circuit is built on a solderless breadboard mounted in a plastic pencil box. There are 3 Circuit Stickers in the memory keyer. One Circuit Sticker is a code practice oscillator that provides side tone. The other 2 Circuit Stickers are each a PICAXE microcontroller circuit. One PICAXE is handling the iambic paddle inputs and the other PICAXE is providing the memory function. The speed pot is wired to an A-to-D converter input on both microcontrollers so they send Morse Code at the same speed.

There are 2 programs available for the one PICAXE that's performing the memory function. One program provides 3 CW memories. Pushing one of the 3 push buttons on the unit causes the message in the memory associated with that push button to be sent. The programming of the messages in the memories is changed by changing the PICAXE program and reloading it. PICAXE programming is easy enough that changing the messages that way is not inconvenient.

The other program that goes in the memory function microcontroller is a CW trainer. Pushing one of the push buttons causes the PICAXE to send 100 characters of random code in 5 letter groups. Pushing another push button causes the random code that was just sent to be repeated. This allows for practice code to be sent then the speed can be lowered and the same code sent again to check how it was copied. Pushing the first push button again causes a new set of random code to be sent.

The trainer program uses the third push button in combination with the speed pot to set how much of the character set programmed in the PICAXE is used when selecting the random characters to send. Holding the third push button down causes the last character of the partial character set to be sent repeatedly at a relatively slow speed. Turning the speed pot knob while holding that push button causes the last character to change. When that push button is released the partial character set is fixed. A beginner can start with a small set of characters and as he learns he can turn the knob up to select a larger set until he knows the entire code.

More information and the source code for the PICAXE programs is available on my web site.

CW Interface

An example of a circuit built "ugly" style with a Circuit Sticker is the CW interface shown in Figure 5. This circuit connects to a computer serial port or serial port USB adapter and allows a logging program to key a rig to send CW. Either the DTR line or the RTS line, depending on how the unit is wired, is used to control a

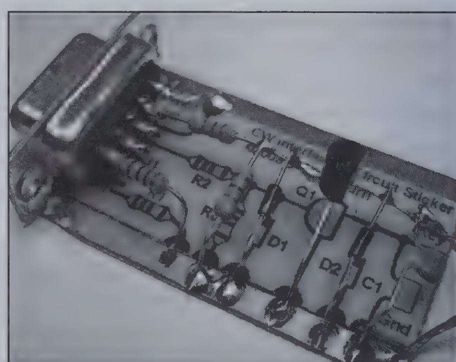

Figure 5—CW interface Circuit Sticker circuit.

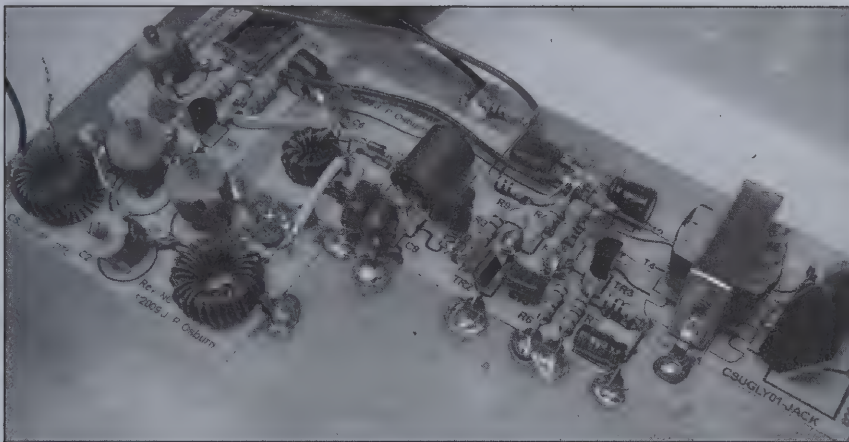

Figure 6 - Improved microR1 Kitlet built on a Circuit Sticker.

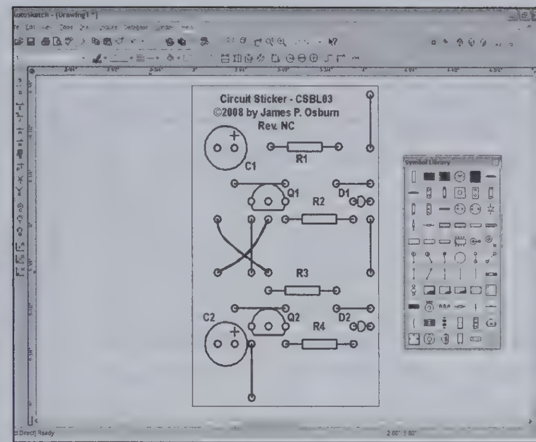

Figure 7—Screen capture of CAD program.

PN2222A keying transistor. When the signal line has a positive voltage the transistor turns on which keys the transmitter. Most logging programs including N3FJP and N1MM work with the interface. The components are positioned above the Circuit Stickers and connections are made by soldering their leads together. Connections to the ground plane are made around the perimeter of the Circuit Sticker.

Improved Micro-R1

Another example of a circuit built "ugly" style with a Circuit Sticker is the receiver shown in Figure 6. This is the Improved microR1 "kitlet"" available from Kanga US [10]. The kitlet comes as a bag of parts without any kind of board. The intent is to download the documentation and then build the circuit on bare copper PCB material. The Circuit Sticker isn't included in the kit.

There are 4 Circuit Stickers for the receiver circuit, one for the preselector, one for the crystal oscillator, one for the mixer/audio amplifier, and one for the headphone connector. An audio transformer mounts between the Circuit Stickers for the audio amplifier and the headphone connector. Again as in the CW interface, the components are positioned above the Circuit Stickers and connections are made by soldering their leads together. Connections to the ground plane are made around the perimeter of the Circuit Stickers.

Why use Circuit Stickers

I've lead a few group building sessions in which we were building a circuit on perf board. There are mistakes that the builders can easily make when there's no component legend on the board.

When using a construction technique that doesn't have a component legend on the board it's too easy to build a circuit mirrored horizontally or vertically. If there's a diagram available that shows component layout it might be a top view or it might be a bottom view and which one it is might be confused. Many times it's necessary to orient the board and the diagram to match. If that's not convenient then it's necessary to imagine the layout flipped or rotated from what's shown in the diagram. If the diagram is attached to the board, as it is with Circuit Stickers, then it's always oriented correctly and the process of imagining the board flipped or rotated is eliminate and so are the errors that causes.

Without a component legend it's easy to put components in the wrong spots or orientated incorrectly. There are many components, such as resistors, that are identical in appearance. Without a component legend it might be known that a resistor is installed in a location but which resistor is it? The Circuit Sticker will indicate that a specific resistor is to be installed in a specific location. Many components, such as electrolytic capacitors, diodes, transistors, etc., must be installed in the correct orientation. The Circuit Sticker will indicate that orientation.

Using Circuit Sticker reduces the number of errors made in circuit construction. A board with a Circuit Sticker has an indication of what the circuit is and what connections are made to it. A board with a Circuit Sticker looks better than a bare board.

CAD Programs for Circuit Sticker Design

I've tried a few different programs for designing Circuit Stickers including PCB layout programs and drafting programs. My preference is the computer aided drafting program Autosketch™ marketed by Autodesk™ [11]. The CAD program allows the easy placement and editing of the components, jumpers, nomenclature, etc. A screen capture of Autosketch working on the previous LED blinker circuit is shown in Figure 7.

Symbol Libraries for Circuit Sticker Design

In the screen capture notice there's a symbol library. Symbol libraries are very important in design work. The symbol library developed for Circuit Stickers is small but it's development is still in their infancy. As the use of Circuit Stickers grows so will the symbol library. Currently there are symbols for a few components, jumpers, and connectors. There are also a few symbols for various types of perf board and sections of solderless breadboard to insure that Circuit Stickers are correctly laid-out for the target board. The symbol library can be downloaded from my web site at http://www.indianakits.com/symbollib/.

Web Based Circuit Sticker Design

The Klunky web based schematic editor has symbols added that allow it to be used to design Circuit Stickers. Klunky is available on my web site at http://klunky.indianakits.com/. Figure 8 shows a screen capture of Klunky while editing a version of a LED blinker Circuit

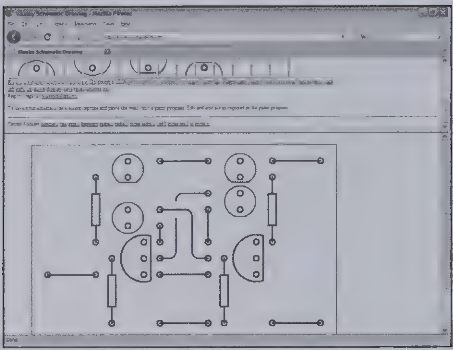

Figure 8—Screen capture of Klunky schematic editor.

Sticker. Using a CAD program is preferable to the online editor in that the Klunky editor is a clunky, clumsy, thing to use. When printing Circuit Stickers from Klunky the printer page needs to be setup to scale the output by 26% so the symbols will fit the standard 0.1" spacing between holes on perf boards and solderless breadboards.

Materials for Making Circuit Stickers

The Circuit Stickers I make are made from green colored paper and "light traffic" indoor carpet tape. Any color of paper can be used but I think they look best when I use green paper. I've tried to make Circuit Stickers using office labels but they don't stay stuck.

I've also tried other kinds of tape but the carpet tape seems to work best. Other types of tape either have too much adhesive and you wind up with a gooey mess or not enough adhesive and the Circuit Sticker doesn't stay stuck. The carpet tape is also 1.88" wide which, so far, has been wide enough for all of my designs.

Printing Circuit Stickers

I do the following steps when printing Circuit Stickers. First I print lines on the back of sheet of the colored paper that will allow me to properly align the carpet tape on the Circuit Sticker. Figure 9 is a screen capture from the CAD program with a drawing of the tape lines. The lines are necessary to insure that every Circuit Sticker is fully covered with tape.

Then I use the CAD program array command to create a full sheet of Circuit Stickers. Figure 10 is a screen capture from the CAD program with an array of Circuit Stickers to be printed. Typically I can get a couple dozen or more Circuit Stickers on one sheet of letter size paper. I print out the array on the front of the colored paper and I'm ready to apply the carpet tape.

Applying The Tape

I apply the carpet tape so there's always a seam of 2 edges in the tape in the middle of the Circuit Sticker. When I first started making the Circuit Stickers I would make them with out the seam and that made it very difficult to remove the release paper from the tape when the Circuit Sticker is being applied to the board. The edges of the carpet tape seem not to have any adhesive. That allows you to lift up the release paper from the seem and pull it off.

Applying the tape to the paper also takes a little bit of skill and patience to get it on aligned with the lines on the back of the sheet. It also takes a little bit of skill and patience to get the tape on smooth with no wrinkles or bubbles. Typically there are 4 strips of tape on the back of sheet of Circuit Stickers. I put the paper face down on a clean surface with the tape lines up. I then eyeball how long a piece of tape I need and I cut that much from the roll of carpet tape. I then put the tape down on paper lined up with the tape lines. When I put the next strip of tape down on the paper I don't try as hard to line up with the tape lines but I try instead to get the edge of it butted up against the edge of the tape already on the paper. I don't want to leave too much of a gap. After all the strips of tape are on the paper it's ready for cutting out the individual Circuit Stickers.

Cutting Out Circuit Stickers

I've tried cutting out the Circuit Stickers from an array of them printed on a sheet of colored paper with a paper cutter but I find it difficult to cut precisely with that. For me the best way to cut out the Circuit Stickers is to use a pair of scissors and do it entirely by hand. The paper is a little thick because of the carpet tape on the back but I have no problem cutting it with regular scissors. There's no space between the individual Circuit Stickers in the array so I have to be a little careful that I don't mess up because I'll mess up 2 Circuit Stickers at a time. There's not much skill required though and in just a couple of minutes I have a nice pile of Circuit Stickers. I put the pile of Circuit Stickers in a plastic bag until I'm ready to put them in individual bags.

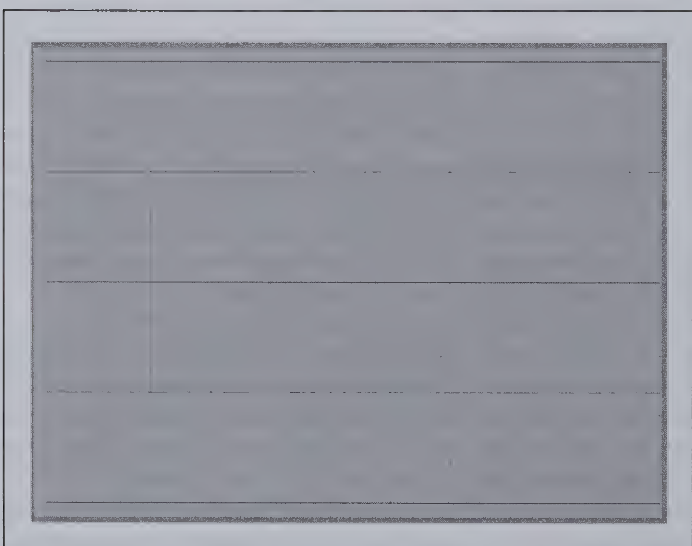

Figure 9—Tape lines.

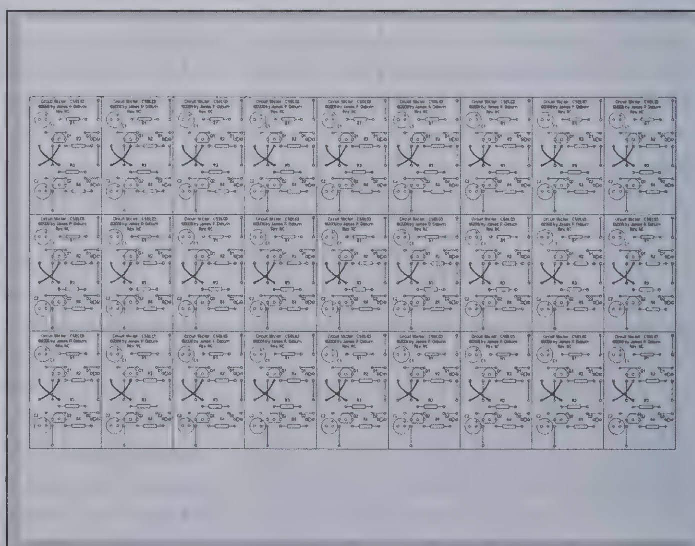

Figure 10—Array of Circuit Stickers.

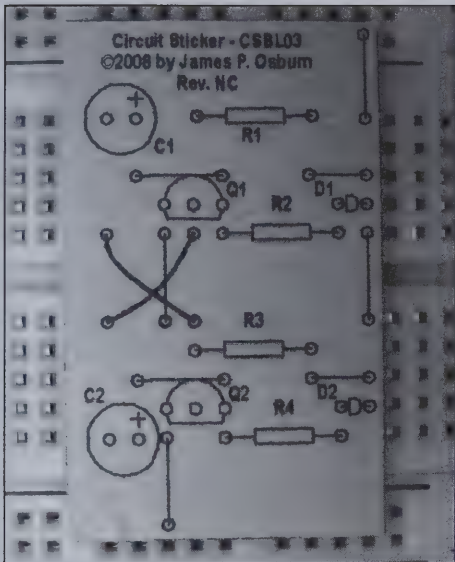

Figure 11—Circuit Sticker applied to solderless breadboard.

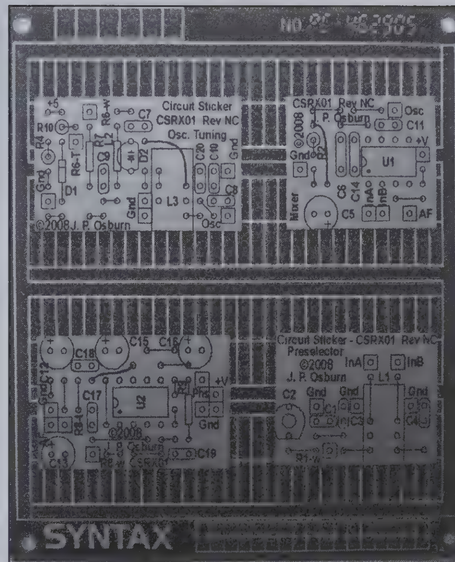

Figure 12—Circuit Stickers applied to perf board.

Applying Circuit Stickers to Boards

When building a Circuit Sticker board it's necessary to get the Circuit Sticker stuck to the board correctly aligned with the board's hole pattern and preexisting connections. I design my Circuit Stickers for solderless breadboards so that the edges of the Circuit Stickers are on the ridges in-between the contacts. See Figure 11. I design my Circuit Stickers for perf board so that the corners of the Circuit Sticker are in centered over the holes on the perf board. See Figure 12. That allows the Circuit Sticker to be applied to the board so the holes that get punched through the Circuit Sticker for the component leads are centered over the board holes.

It's also necessary that the Circuit Sticker is correctly aligned over any preexisting connections in the board. I try to make it clear in the documentation for the Circuit Sticker how it's positioned over the pattern in the board. The Circuit Stickers are fairly forgiving though. If it gets positioned incorrectly it's possible to remove the Circuit Sticker and reposition it without damaging it too much.

Installing Components

Holes must be punched in the Circuit Sticker for the component leads. I have a small set of tweezers with a very sharp point that I use for punching the holes but just about anything with a sharp point can be used. I just scan through the board and punch the holes where indicated on the Circuit Sticker. Once the holes are punched then components are installed just they way there are normally. There's nothing special that needs to be done installing the components because of the Circuit Sticker. It will be easier to install the components compared to boards without the Circuit Sticker because now there's a component legend that shows where the components go and how they are oriented.

Conclusion

One problem with using construction techniques other than printed circuits boards, for example: perf boards, solderless breadboards, bare copper PCB material, and homemade printed circuit boards is the lack of a component legend. The missing component legend results in errors in building the circuit. A technique, that's really a fairly old idea, that mitigates the problem is the use of Circuit Stickers as described in this article. Give Circuit Stickers a try.

Circuits Stickers and kits with Circuit Stickers are available on my web site at http://www.indianakits.com. I've also attended a few hamfests in the Indiana/Illinois area and the QRP ARCI Four Days in May event selling Circuit Stickers and kits. If you look at the bottom of page 51 of the Summer 2009 *QRP Quarterly* you'll see a picture of me at my table at vendor night at FDIM. Sometimes when I complete the design of a new Circuit Sticker I'll give away a few samples via the QRP-L mailing lists. I hope to continue designing and making Circuit Stickers available to the QRP community. It's an very enjoyable aspect of our hobby for me.

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A Listing of Available QRP Kits

John King—KB3WK kb3wk@arrl.net

Model	Band	Size (inches) H	W	D	Wt (lbs)	Power Requirements Volts	TX	RX	Pout
Elecraft — http://www.elecraft.com									
K1	2 bands, 4-band opt.	2.2	5.2	5.6	1.4	9-15	<.8A	55 mA	0-5W
KX1	Several options	1.2	5.3	3	0.56	9-15	<.65A	35 mA	1-4W
K2	160 - 10	2.9	7.8	8.2	3.3	10-15	2.5A	150mA	0-15W
K3	160 - 6	4	10	10	8	15-Nov	4A	0.9A	0.2-10 W
Genesis Radio — http://genesisradio.com.au/									
G40 SDR	40	~1	5.9	7.7		13.8	.25a	1.7a	5
G3020 SDR	30, 20	(New kit; no specs available but similar to G40.)							
Glowbug Kits — http://www.glowbugkits.com/									
1-DER 40	40					1.5v, 90v			200 mW
Hendricks QRP Kits — http://www.qrpkits.com/									
BitX20A	20 SSB					13.8			10W PEP
BitX17A	17 SSB					13.8			10W PEP
DC40B	40 CW					12-13.8			1W
DC30B	30 CW					12-13.8			1W
DC20B	20 CW					12-13.8			1W
MMR-40	40 SSB/CW					12.5-13.8	0.9A	30 mA	6W
PFR-3	40/30/20 CW	1.6	4.4	7.3	1.2	9-12	0.75A	47 mA	5W
Dual Band	Any two, 80-15M	1.6	4.6	5.5	1.1	13.8	.55-.75 A	55 mA	5W
Scout Rcvr	3.5-10 MHz					9			N/A
Juma Kits — http://www.nikkemedia.fi/juma/									
Juma RX-1	80M, 40M	1.65	5.6	2.8		9-15	N/A	50 mA	N/A
Juma TX-1	80M, 40M	1.65	5.6	2.8		12-15	1.5A	N/A	6 W
Juma TRX-1	80M, 40M	1.9	6.3	4		15-Dec	1.2A	60 mA	5W
Juma TRX-2	80M - 10M	2.4	7.2	7.3	3.8	11-15	2.5A	350 mA	10W
Kanga US — http://www.kangaus.com/									
miniR2	40M		2.5	3.5		12			
microR2	40M		2.5	3.5		12			
R2Pro	Any one band					12			
Binaural Rx	40M					12			
microT2	40M					12			1 mW
UQRP TX	Any one band					12			4 W
KD1JV "Melt Solder" Kits — http://kd1jv.qrpradio.com/									
ATS-3B	1 band, 80M-15M		3.1	2.2		6-12	.25-.4A	35 mA	
Kits and Parts.com — http://partsandkits.com									
Kits and Parts.com kits do not easily fit into a spread sheet. Typically, the kits are electronic building blocks, such as filters or amplifiers.									
MFJ — http://www.mfjenterprises.com/									
Cub 9380	80M					12-15	380 mA	36 mA	2 W
Cub 9340	40M					12-15	380 mA	36 mA	2 W
Cub 9330	30M					12-15	380 mA	36 mA	2 W
Cub 9320	20M					12-15	380 mA	36 mA	2 W
Cub 9317	17M					12-15	380 mA	36 mA	1 W
Cub 9315	15M					12-15	380 mA	36 mA	1 W
Oak Hills Research — http://www.ohr.com									
OHR 100A	80	2.5	6	6	1.5	12-13.6	0.85A	0.08A	0-5 W
OHR 100A	40	2.5	6	6	1.5	12-13.6	0.85A	0.08A	0-5 W
OHR 100A	30	2.5	6	6	1.5	12-13.6	0.85A	0.08A	0-5 W
OHR 100A	20	2.5	6	6	1.5	12-13.6	0.85A	0.08A	0-5 W
OHR 100A	15	2.5	6	6	1.5	12-13.6	0.85A	0.08A	0-5 W

Note: Contact the vendors for current specifications, availability, pricing and introduction of new models!

Basic Price $	Tuning Range	Tuning Method	Mixer Type	Filter Poles	BW (Hz)	IF (MHz)	RIT	QSK
300	150 kHz	Varactor	SA602	4	250-800	4.915	Y	Y
300	~5 MHz	Synth	SA602	3	300-2000	4.913	Y	Y
690	Full Band	Synth	DBM	5	100-2200	4.915	Y	Y
1399	.5 to 30, 48-54 MHz	Synth	DBM	8	200-15000	8.215	Y	Y
149 159	95 KHz	Software	Software	Software	Software	DC	Y	Y
90	+/- 25kHz	Crystal+RIT	Regen	N/A	N/A	Regen	Y	N
90	147 kHz	Cap	DBM	4	~2800	11	N	N/A
90	60 kHz	Cap	DBM	4	~2800	12.96	N	N/A
50	0 kHz	Crystal	Switching		~800	DC	N	Y
50	0 kHz	Crystal	Switching		~800	DC	N	Y
50	0 kHz	Crystal	Switching		~800	DC	N	Y
190	130 kHz (x2)	PTO	SA602	4	2000	10	N	Y
	Full Band	Synth	SA612	4	300	4.9152	Y	Y
210	Full Band	Synth	SA612	4	~300	4.9152	Y	Y
40	Full Band	Regen	Regen	N/A	300-2000	DC	Y	N/A
91.5	3.5 - 7.5 MHz	Synth	Switching		2500	DC	N	Y
119.55	Full Band	Synth	N/A	N/A	N/A	DC	N	N
189.08	Full Band	Synth	Switching		2400, 900	DC	Y	Y
840.26	Full Band	Synth	Switching	N/A	2400, 700	Phasing	Y	Y
95	100 kHz	Cap	DBM	4	2500	Phasing	N/A	N/A
95	100 kHz	Cap	DBM	4		Phasing	N/A	N/A
115	Requires ext. VFO		DBM			Phasing	N/A	N/A
115	Full Band	VFO	DBM			Phasing	N/A	N/A
95	Single Freq	Crystal	DBM			Phasing	N/A	Y
25	A Few kHx	VXO	N/A				N/A	Semi
	Full Band	Synth		4	600			Y
100	60 kHz	Varactor	SA602	3		10	N	Y
	60 kHz	Varactor	SA602	3		12	N	Y
	20 kHz	Varactor	SA602	3		6	N	Y
	60 kHz	Varactor	SA602	3		10	N	Y
	50 kHz	Varactor	SA602	3		10	N	Y
	50 kHz	Varactor	SA602	3		12	N	Y
150	Any 70 kHz segment	Varactor	SA602	4	400-1200	9	Y	Y
150	Any 70 kHz segment	Varactor	SA602	4	400-1200	9	Y	Y
150	Any 70 kHz segment	Varactor	SA602	4	400-1200	9	Y	Y
150	Any 70 kHz segment	Varactor	SA602	4	400-1200	9	Y	Y
150	Any 70 kHz segment	Varactor	SA602	4	400-1200	9	Y	Y

Model	Band	Size (inches) H	W	D	Wt (lbs)	Power Requirements Volts	TX	RX	Pout
QROlle (Sweden) — http: www.qrolle.se									
QROlle II, SSB/CW	All bands, 80M - 17M					13.5			1-10W
QRPme — http://www.qrpme.com/									
Super Tuna TX	Any HF band						12		1W
Two Tinned Tunas	40						12		N/A
Tuna Topper	40						12		5
Sudden Storm RX	80M, 40M, 30M, or 20M								N/A
QRP Project (Germany) — http://www.qrpproject.de/UK/indexuk.html									
Blue Cool Radio	40M-17M (SSB/CW)	1.6	6.3	4		12v nom.		50 mA	5W
Bodan 6	6M		6.3	4			200 mA	40 mA	1-2W
Hegau	40M					8-14			1W
Hohentweil	2M (SSB/CW)					13.8	0.6A		5W
Miss Mosquita	40M	1	3.9	3.9		10-14	380	30	5W
Sparrow	80M - 17M versions	1.9	4.6	4.9		10-15V	630 mA	80 mA	5W
Tramp	160M - 10M	2.2	6.6	4.1	1.6	11-15V		70 mA	0-8W
Ramsey Electronics — http://www.ramseyelectronics.com									
HRxx Rcvr	20M, 30M, 40M	1.5	5	5.3	1.2	9			N/A
QRPxx TX	20M, 30M, 40M				1.1	12V	200 mA		0.75 -1W
Small Wonder Labs — http://www.smallwonderlabs.com									
SW80+	80	2	4.1	4	0.75	10-15	0.4A		2.5
SW40+	40	2	4.1	4	0.75	10-15	0.4A		2.5
SW30+	30	2	4.1	4	0.75	10-15	0.4A		2.5
SW20+	20	2	4.1	4	0.75	10-15	0.4A		2.5
Rock-Mite	See Note 3	2	2.5	1		8-15			0.5
PSK-40	40	~1	4.6	5.3		10-15	1A		4
PSK-30	30	~1	4.6	5.3		10-15	1A		4
PSK-20	20	~1	4.6	5.3		10-15	1A		4
Warbler	80	~1				10-15	<1A		3
Ten-Tec — http://www.tentec.com									
1380	80	2.75	6	6	2.3	12-14	0.8A	80 mA	3
1340	40	2.75	6	6	2.3	12-14	0.8A	80 mA	3
1330	30	2.75	6	6	2.3	12-14	0.8A	80 mA	3
1320	20	2.75	6	6	2.3	12-14	0.8A	80 mA	3
Vectronics — http://www.vectronix.com									
VEC-1002K	2M FM Rx	1.75	3.75	3.25		9			
VEC-1006K	6M FM Rx	1.75	3.75	3.25		9			
VEC-1010K	10M FM Rx	1.75	3.75	3.25		9			
VEC-1120K	20M Rx	1.75	4.75	5		9			
VEC-1130K	30M Rx	1.75	4.75	5		9			
VEC-1140K	40M Rx	1.75	4.75	5		9			
VEC-1180K	80M Rx	1.75	4.75	5		9			
VEC-1202K	2M FM Tx	1.75	4.75	5		12-14	1.5A		5W
VEC-1220K	20M CW Tx	1.75	3.5	3.5		12-15	350 mA		1W
VEC-1230K	30M CW Tx	1.75	3.5	3.5		12-15	350 mA		1W
VEC-1240K	40M CW Tx	1.75	3.5	3.5		12-15	350 mA		1W
VEC-1280K	80M CW Tx	1.75	3.5	3.5		12-15	350 mA		1W
Wilderness Radio — http://www.fix.net/~jparker/wild.html									
Norcal 40A	40	2.25	4.5	4.5	0.94	9.5-14	0.3A	17 mA	3
SST40	40	1.5	3.2	3.5	0.44	9-16	.2-.3A	15mA	2
SST30	30	1.5	3.2	3.5	0.44	9-16	.2-.3A	15mA	2
SST20	20	1.5	3.2	3.5	0.44	9-16	.2-.3A	15mA	2
Sierra	All	2.8	6.6	7	2	9-16	.2-.3A	35mA	1.5-3

(This list is as complete as possible, but may have some omissions. Any kit companies not listed are encouraged to contact the author)

Basic Price $	Tuning Range	Tuning Method	Mixer Type	Filter Poles	BW (Hz)	IF (MHz)	RIT	QSK
712	Full Band	Synth	DBM	4	2400, 700	5	Y	Y
35	Crystal	None	N/A	N/A	N/A	N/A	N/A	N
30	Crystal	Crystal	N/A	N/A	N/A	N/A	N/A	N/A
30	Amp Only	Amp Only	N/A	N/A	N/A	N/A	N/A	N/A
35	Crystal	Crystal	SA602	N/A		DC	N/A	N/A
445	Full Band	Synth	Switching	3	Variable	4.915	Y	Y
148	35-40 kHz	VCXO	SA612	N/A	750	DC	N	Y
106	few kHz	VXO	SA612	N/A	600	DC	N	Y
500	500 kHz	VCXO	DBM	8	2400	10.7	Y	Y
112	40kHz	VCXO	SA602	6	500	4	Y	Y
267	CW portion each band	Synth	SA612	8	400	4	Y	Y
433	100 kHz	PLL	NE612	4	500	4.915	Y	Y
40	250 kHz	Varactor	SA602	N/A		DC		
45	7 kHz	VCXO	N/A	N/A	N/A	N/A	N/A	N/A
55	40 kHz	Varactor	SA602	3	600	8	N	Y
55	40 kHz	Varactor	SA602	3	600	4	N	Y
55	40 kHz	Varactor	SA602	3	600	7.68	N	Y
55	40 kHz	Varactor	SA602	3	600	9	N	Y
29	0 kHz	None	SA602	1	~ 500	DC	N	Y
115	3.5 kHz	Software	SA602	4	3500	9	N/A	N/A
115	3.5 kHz	Software	SA602	4	3500	9	N/A	N/A
115	3.5 kHz	Software	SA602	4	3500	9	N/A	N/A
55	2.5 kHz	Software	SA602	3	2500	DC	N/A	N/A
119	50 kHz	Varactor	SA602	4	1000	11	Y	Y
119	50 kHz	Varactor	SA602	4	1000	11	Y	Y
119	50 kHz	Varactor	SA602	4	1000	14.32	Y	Y
119	50 kHz	Varactor	SA602	4	1000	6.14	Y	Y
35	FM Portion	?	MC13135			10.7	N/A	N/A
35	FM Portion	?	MC13135			10.7	N/A	N/A
35	FM Portion	?	MC13135			10.7	N/A	N/A
30	Full Band	Var. Inductor	SA612	N/A		DC	N/A	N/A
30	Full Band	Var. Inductor	SA612	N/A		DC	N/A	N/A
30	Full Band	Var. Inductor	SA612	N/A		DC	N/A	N/A
30	Full Band	Var. Inductor	SA612	N/A		DC	N/A	N/A
99	Fixed Freq.	Crystal	N/A				N	
30	8 kHz	VCXO	N/A					Y
30	<8 kHz	VCXO	N/A					Y
30	<8 kHz	VCXO	N/A					Y
30	<8 kHz	VCXO	N/A					Y
145	40 kHz	Varactor	SA602	4	350	4.915	Y	Y
90	20 kHz	Varactor	SA602	3	350	4	N	Y
90	20 kHz	Varactor	SA602	3	350	4.194	N	Y
90	20 kHz	Varactor	SA602	3	350	3.932	N	Y
215	150 kHz	Cap	SA602	4	150-1500	4.915	Y	Y

(Specifications, pricing and availability may change — check with each vendor for current information)

CQWW CW 2009: A QRP Effort

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Almost every year for the past 10+ years I have done a QRP effort at the local club using my call in the CQ WW CW Contest. I missed the last two years because of a flood here in Findlay Ohio that put me out of commission in 2007, and last year my mother and my father in law both had health issues the kept me busy all fall. This year I was able to get prepared and participate.

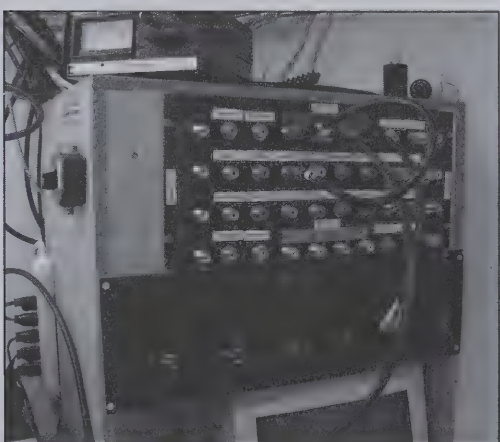
I am fortunate to belong to a radio club that has a clubhouse on about 5 acres of land here in Findlay. Since we moved to a house on a city lot back in 1990, I have spent most of my time maintaining the station at the local club. (My home station consists of a low tri-bander, an 80/40 dipole, and an all-band vertical.) The antenna system at the club is big enough that maintenance is required every year. There was a lot to do in 2009 since I was unable to do any work on the antennas the prior two years. In addition, the club had acquired two "new" antennas that needed to be assembled and erected. Almost no-one else in the club climbs, so it was up to me to get all the antenna work done. There is usually a large ground crew that shows up when I climb!

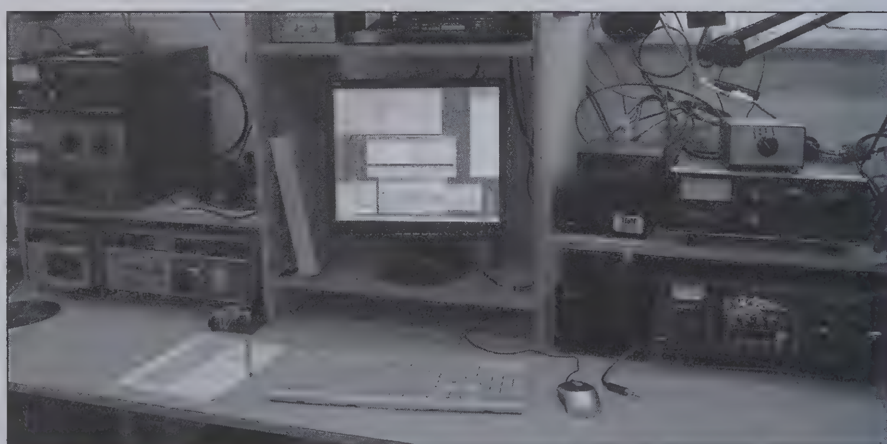
I started work in August. All the antennas and rotors were in a state of disrepair, so everything needed to come off the towers, be repaired, and then be re-installed on top of the towers. All the beams were taken down and the remains of the wire antennas were removed from the towers. When that was done, 2 ten meter beams, a 15 meter beam, 2 twenty meter beams, and a 2 element 40 meter beam were on the ground. Three rotors were also taken down

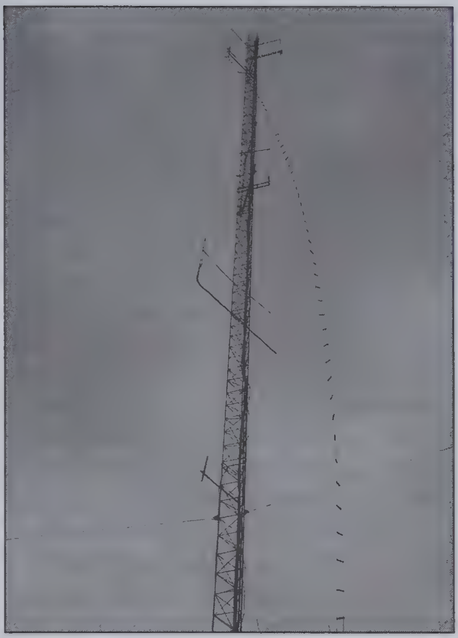
and taken to CATS in Pemberville Ohio (highly recommended!) for repair. Three towers were involved with the beams, and three other towers held wires. Five of the towers are between 70 and 90 feet tall, and one is 170'.

Assembly of the new antennas took several days. The two new antennas were a 5 element 10 / 5 element 15 meter Force 12, and a 6 element 20 / 3 element 40 Force 12. These are large antennas on booms that are longer than 40 feet, and they are the heaviest antennas I had ever worked with. The beams that had been taken down were repaired.

Then the process of getting everything back in the air started. The weather this past fall was some of the best we have had—the sun was out, and winds were calm. The rotors were installed in the towers, and the long slow process of getting the antennas to the top of the towers started. We use a tram-line system to raise the antennas to the top of the towers. A heavy rope is strung between the top of the tower (about three feet above where the antenna is attached) and the ground some distance away from the tower. The antennas is suspended from a pulley and hauled up to the top along the tram-line. The new antennas were big enough that we had to drop the top set of guy wires so that the elements would clear them and the antennas could be hoisted into position. Once the antenna







was at the top of the tower, I would climb up and bolt it in place. Each large antenna took a day to raise and bolt in place.

Once the beams were in the air I put the wires up. A dual band 80/160 inverted vee was hung at 80 feet, and an open wire fed dipole for 160 was hung at 150'. I also put up a 1/4-wave vertical for 80 with elevated radials, and gamma matched one of the towers for 160. 70 1/4-wave radials were laid on the ground for that antenna. A pair of delta loops were put broadside to Europe and phased. Finally a set of beverage receive antennas were erected. They are two wire switchable beverages at right angles to each other so I have 4 different directions I can switch between. They are only 285' long, but seem to hear better than most of the other low band wire antennas on 80 and 160.

Amazingly enough, all the antenna work got done in time for the contest. I was even able to get on ARRL Sweepstakes and be sure they all worked (they did!).

The station inside did not need much work. We have 5 operating positions set up with a patch panel and switches so we can get any antenna to any operating position. The main rig is a TenTec Orion II, and next to it is a TenTec Omni6 that I would use as a second radio. I use N1MM software as a contest logging program. It will log the frequency of the QSO and send the CW from the proper radio.

CQ WW CW is always the weekend right after Thanksgiving. I was not quite sure what to do this year—all the antennas were set to go and the radios were readyI had nothing I had to do on Friday during the day.

I was in the chair at the beginning of the contest. I spent the entire weekend at the club working the contest. The first night a took an hour off to sleep, and the second night I took off about 5 hours—a few more than I should have! During the weekend my wife brought in lunch and dinners for me. The rest of the time I had snack I ate. Most of the time I was in front of the radio and plugging away.

I only used two radios a short time on Sunday. The N1MM software will toggle between two radios so you can Search and Pounce on one radio while calling CW on another. For the short time I attempted two radio operation I picked up a couple of new multipliers. Two radio operation is something I need to work on this year and take advantage of next year. It seems to work—even at QRP levels!

Checking the results on the 3830 list, I was once again beaten by KR2Q on the east coast. It is tough to overcome that advantage of being on the east coast! I do notice that there are more QRP entries this year, and more entries that are producing good scores. The top ten scores in the US from the 3830 list are shown in the table below. My claimed score from my summary sheet is:

Band	QSOs	Pts	Cty	Zn
1.8	16	30	2	4
3.5	35	76	15	12
7	109	292	51	19
14	282	797	86	29
21	137	365	62	19
28	6	12	4	4
Total	**585**	**1572**	**220**	**87**

Claimed Score: 482,604

The score was down from previous years—I attribute that to the almost complete lack of sunspots. I'll be back next year, with two radios and more antennas!

USA SOAB QRP

Call	QSOs	Zones	Cntry	hr	Score	Club
KR2Q	762	91	269	39	758,880	
N8ET	585	87	220	40	482,604	MRRC
K4LY	562	80	208	33	437,184	Carolina DX Assn
N1TM	543	72	214	29	424,710	YCCC
W8QZA(@NØKE)	461	83	176	40	310,541	SCCC
K8CN	381	52	152	19	216,648	
N7IR	305	87	143	28	183,770	Arizona Outlaws
W6AQ	282	66	113	30	136,219	SCCC
KT8K	244	120	45	~20	109,560	MRRC
KG4JGQ	211	65	131	14	104,076	N. Carolina DX Assn

QRP Contests

Jeff Hetherington—VA3JFF contest@qrparci.org

Recently there was a wonderful discussion thread on QRP-L about QRP contesting and how to improve participation and enjoyment for all entrants. There were many good suggestions that came forward, and as a result there will be a few changes to the QRP-ARCI Contests going forward that will hopefully improve the overall contesting experience for all involved. The first change is the addition of a Multi-Operator category in the Spring and Fall QSO Parties. This will allow for any combination of operators and transmitters located in a centralized location to operate under a single callsign. This has been an area of increased interest over the past couple years and should prove to be a popular category going forward. The second discussion topic was on the updating of the claimed scores on the website. My resolution for 2010 is that the contest website will be updated more frequently. I have fine tuned my method for exporting data to the tables for the website, and there will be an improvement in this area going forward as well. There was also a lot of discussion about whether or not there were too many QRP Contests. At this point in time, QRP-ARCI sponsors 12 contests in the year. Some contests such as the Spring and Fall QSO Parties have strong participation year after year. Others suffer from low participation rates and in the past have been changed to make room for new contests such as the Grid Square Sprint, Pet Rock Celebration and the VHF Contest. In the future, we will look at eliminating low participation contests entirely. This will be done only after looking at each situation on an individual basis, as there has also been a few good suggestions for new contests that have been passed along to me. Score reporting was the other big topic discussed on QRP-L. Currently, logs and summaries are submitted by email (any format) or snail mail. Because of the snail mail submission delays, contest entries are due one month after the contest. Other groups have eliminated the snail mail entries and only accept electronic contest submissions. We are investigating an on-line contest submission form that will make it easier to submit entries immediately following a contest. As we get the online submission form working, we will look at a shorter contest deadline for future years. The QRP-ARCI Staff list discussion also brought up some other ideas that are still in the exploratory stages, and may make for some great improvements in QRP-ARCI Contests in the not too distant future.

Top 5 Silent Key Memorial Contest:

Bob Patten—N4BP:	5,880 Pts
Dave Brown—K8AX:	5,805 Pts
John Ketzler—W9TFC:	5,770 Pts
Andrew Measday—WA5RML:	5,140 Pts
Tim Colbert—K3HX:	2,961 Pts

2009 Silent Key Memorial Sprint

The 2009 running of the Silent Key Memorial Contest saw a total of 13 participants taking the opportunity to remember the QRPers that have come before us and helped us to enjoy this great hobby. This was one of the closest contests I have seen, with the top four entrants separated by only 740 points! Leading the way in scoring was Bob Patten, N4BP with 5,880 points just edging out second place finisher Dave Brown, K8AX and his total of 5,805 points. Third place was claimed by John Ketzler, W9TFC with 5,770 points and Andrew Measday, WA5RML took fourth place with 5,140 points.

Top 3 September VHF Contest

John Isham—N1QLM:	4,400 Pts
Bob Witte—KØNR:	1,176 Pts
Pavel Konvalinka—OK1KZ:	300 Pts

2009 QRP ARCI VHF Contest

Five QRPers submitted logs for the VHF Contest this past September. This was the second running of the VHF Contest, and the first time it has been run in the September time slot. I know that there were more QRPers that were active in the contest, and there were more QRPers that submitted logs to the ARRL for the contest. Since this contest runs concurrently with the ARRL September VHF Contest, as is also the case with our milliWatt Field Day offering in June, there is the possibility that we are not adding enough to convince participants to submit two sets of logs. Since there is no specific QRP base station category in the ARRL VHF Contest, hopefully we can get the word out to the QRPers that we can recognize their efforts against other QRPers directly. John Ishlam, N1QLM ran on 50 MHz, 144 MHz and 432 MHz with his Yaesu FT897D turned back under 10 watts to claim top spot in the contest with 44 QSOs and 4,400 points. Donald C. Younger, W2JEK used a Ten-Tec 6m Transverter and a 2m Alinco handheld on 50 MHz and 144 MHz for 42 QSOs and 2,352 points and a second place finish. QRP-ARCI VHF Columnist Bob Witte, KØNR took third place by using his FT-817 on 50 MHz, 144 MHz and 432 MHz for 16 QSOs and 1,176 points. Our fourth place finisher was Pavel Konvalinka, OK1KZ who used a 10W transceiver across 50 MHz, 144 MHz, and 432 MHz for 12 QSOs and 300 points.

Mark Your Calendars!

3 & 4 April 2010:
Spring QSO Party

30 May 2010:
Hootowl Sprint

26 & 27 June 2010:
milliWatt Field Day

2009 Fall QSO Party

Once again, the Fall QSO Party proved to be our most popular activity of the year with 105 logs received, six teams entered, and DX logs received from Norway, Spain, Azores and Scotland. Three checklogs were also received, and all would have been certificate winners—so I guess we'll have to work harder to publicize the importance of submitting your logs outright, no matter how small the effort may seem. There was a new name appear at the top of this contest as Jay Schwisow, KT5E

2009 Silent Key Memorial Sprint

NAME	Call	S-P-C	BANDS	POWER	#QSO's	Pts	SPC	Mult	Bonus	Score
Bob Patten	N4BP	FL	20	< 5W	17	70	12	7	0	5880
Dave Brown	K8AX	OH	20	< 5W	7	23	5	7	5000	5805
John Ketzler	W9TFC	WI	20	< 5W	5	22	5	7	5000	5770
Andrew Measday	WA5RML	TX	20/40	< 5W		10	2	7	5000	5140
Tim Colbert	K3HX	PA	20/40	< 5W	13	47	9	7	0	2961
Barry Ives	AI2T	NY	20/40	< 5W	10	41	9	7	0	2583
Larry Mergen	KØLWV	MO	20/40	< 5W	8	34	7	7	0	1666
Brian Campbell	VE3MGY	ON	20	< 1W	8	22	7	10	0	1540
Robert MacKenzie	VA3RKM	ON	20/40	< 5W		29	7	7	0	1421
Scott McMullen	W5ESE	TX	20/40	< 5W	7	32	6	7	0	1344
Edwin "Ted" Albert	AB8FJ	OH	ALL	< 5W	4	17	4	7	0	476
Walt Robbins Jr	WA9ZES	IN	40	< 5W	3	12	3	7	0	252
Jim Cluett	W1PID	NH	20	< 5W	1	5	1	7	0	35

Top 10 Fall QSO Party:

Jay Schwisow—KT5E:	991,872
Charles Fulp, Jr—K3WW:	844,865
Bob Patten—N4BP:	383,838
Randy Foltz—K7TQ:	351,680
Mark McLauchlin—W7FLY:	338,520
Robert MacKenzie—VA3RKM:	254,016
Jim Stafford—W4QO:	220,864
Jim Rinehart—K9PX:	216,405
Hank Kohl—K8DD:	192,000
Joe Vrabel—KD2JC:	178,360

Fall QSO Party Team Results:

Aluminum Kings:	1,073,471
The Milliwatters:	458,730
CCO Beaverboys:	425,040
Old Goats:	167,321
MONTeam:	87,941
Knightlites:	26,355

took home first place honours with a total of 991,872 points holding off Charles Fulp Jr., K3WW and his total of 844,865 points. Bob Patten, N4BP was the top scoring high band entrant and took home third place overall with 383,838 points. Randy Foltz, K7TQ and Mark McLauchlin, W7FLY took fourth and fifth place respectively with 351,680 points and 338,520 points. The team category made for some hot competition, with the Aluminum Kings (N4BP, K7TQ, NØUR, K4BAI, KØFRP) taking the prize with 1,073,471 points. The Milliwatters team needed some serious co-ordination to maintain the five operators at a time rule, but their seven member team (K8DD, K9JWV, AA4XX, N4HAY, N8LJ, N6GA, WB5FKC) proved that it is possible to do more with less and scored 458,730 points. The Contest Club Ontario Beaverboys (VA3RKM, VA3DF) took the third place bragging rights with 425,040 points.

Until next time, keep your power down and your QSO rates up.

—73/72, Jeff, VA3JFF

Silent Key Memorial Sprint Soapbox

Wx was sunny and warm, operated portable at Blenden Woods Metro Park in Columbus, OH—K8AX.

There was two (2) hours of my life that I won't get back! Poor band condx and/or low turn-out made for slim pickings. Very grateful to KØLWV and K9IS for helping me avoid a shutout! Operated from my backyard in the Texas Heat. See you in the fall contest!—WA5RML.

Quiet, seemingly few participants—K3HX.

My 200ft long wire broke in a storm, so I used my 20m inverted vee and tuner for all QSOs.—AI2T.

Thanks for the contest, condx poor but still had fun.—KØLWV.

The usual poor summer conditions. Glad to work Rich in VE4.—VA3RKM

Propagation seemed very poor, and participation may have been low. Hope we begin seeing some sunspots in the new cycle. —W5ESE

Managed one contact on 15 meters after calling CQ for a while. Only heard one contest station on 40 meters.—AB8FJ

Fall QSO Party Soapbox

It was a fun QSO party but I was disappointed at the lack of participation especially in the evening hours. This was my first ARCI QSO Party but I still expected more. Both 40m and 80m were open nicely but very few answering my CQ or calling CQ. There was a nice opening on 20m to Europe both days. I hope that as propagatoin improves so will activity.—KT5E

Mostly called CQ while scanning photographic slides for a Historical Society project …—K3WW

After listening to 40M briefly Saturday afternoon, I decided to enter as high band. 40m had S9+10 dB noise and JARTS RTTY extending below 7030. Unfortunately, 15m never really opened and 10m was a washout as expected. 20m was a struggle due to high noise levels, usually S7. Wierd part was that the noise peaked at 14060 and dropped off by three S-units at 14050 and below, and at 14070 and above!—N4BP

Not the greatest condx on 20m, but the

2009 QRP ARCI VHF Contest

NAME	Call	S-P-C	BANDS	POWER	#QSO's	Pts	SPC	Mult	Score
John Isham	N1QLM	MA	50-144-432	< 10W	44	55	20	4	4400
Donald C. Younger	W2JEK	NJ	50-144	< 10W	42	14	42	4	2352
Bob Witte	KØNR	CO	50-144-432	< 5W	16	21	8	7	1176
Pavel Konvalinka	OK1KZ	Czech Rep	50-144-432	< 10W	12	15	5	4	300
Arnold Olean	KØZK	ME	50	< 5W	3	3	3	7	63

2009 QRP ARCI Fall QSO Party

NAME	Call	S-P-C	BANDS	POWER	#QSO's	Pts	SPC	Mult	Score	Team
Jay Schwisow	KT5E	CO	ALL	< 5W	333	1312	108	7	991872	
Charles Fulp, Jr.	K3WW	PA	ALL	< 5W	302	1195	101	7	844865	
Bob Patten	N4BP	FL	Hi Bands	< 5W	248	962	57	7	383838	Aluminum Kings
Randy Foltz	K7TQ	ID	ALL	< 5W	186	785	64	7	351680	Aluminum Kings
Mark McLauchlin	W7FLY	WA	ALL	< 5W		806	60	7	338520	
Robert MacKenzie	VA3RKM	ON	ALL	< 5W		576	63	7	254016	Beaverboys
Jim Stafford	W4QO	GA	ALL	< 5W		493	64	7	220864	
Jim Rinehart	K9PX	IN	40	< 5W	188	687	45	7	216405	
Hank Kohl	K8DD	MI	ALL	< 1W	94	400	48	10	192000	milliwatters
Joe Vrabel	KD2JC	NJ	ALL	< 5W	112	490	52	7	178360	
Doug Ferris	VA3DF	ON	ALL	< 5W	118	509	48	7	171024	Beaverboys
Jim Lageson	NØUR	MN	ALL	< 5W	100	392	58	7	159152	Aluminum Kings
Ken Evans	W4DU	GA	ALL	< 5W		344	51	7	122808	
Edward R. Breneiser	WA3WSJ	PA	ALL	< 5W	86	376	44	7	115808	Old Goats
Tim Colbert	K3HX	PA	ALL	< 5W	117	444	37	7	114996	
Paul Kirley	W8TM	OH	Lo Bands	< 5W	105	426	38	7	113316	
Ivin Flint	W9ILF	IN	ALL	< 5W	73	314	49	7	107702	
John T. Lainey III	K4BAI	GA	ALL	< 5W	78	329	44	7	101332	Aluminum Kings
Bruce Olney	N7A	UT	ALL	< 5W	78	333	41	7	95571	
James Rodenkirch	K9JWV	UT	ALL	< 1W	70	305	31	10	94550	milliwatters
Al Dawkins	KØFRP	CO	20/40	< 5W	81	357	31	7	77469	Aluminum Kings
Richard Ferth	VE3KI	ON	ALL	< 5W		275	40	7	77000	
David C. Moses	WØPQ	NE	20/40	< 5W	72	317	34	7	75446	
Paul Beckett	KF7MD	CO	20	< 1W	58	247	30	10	74100	
Jean-Pierre Couture	VA2SG	QC	ALL	< 5W	68	293	35	7	71785	
Paul Stroud	AA4XX	NC	ALL	< 50mW	37	176	20	20	70400	milliwatters
Ed Dybowski	WD7Y	NV	ALL	< 5W	66	266	36	7	67032	
Rollin F. Pettingill	N7RN	AZ	ALL	< 5W		243	38	7	64638	
Dick Hayter	N4HAY	NC	ALL	< 250mW	44	205	21	15	64575	milliwatters
Barry Ives	AI2T	NY	ALL	< 5W	59	265	34	7	63070	
Fred Muehlen	N5WLA	TX	20/40	< 5W	69	309	29	7	62727	
Steve Yates	AA5TB	TX	20/40	< 5W		263	33	7	60753	
Dennis Terribile	WR4I	VA	ALL	< 5W	54	249	33	7	57519	
Andrew Measday	WA5RML	TX	20/40	< 5W		245	31	7	53165	
Scott McMullen	W5ESE	TX	ALL	< 5W	48	222	34	7	52836	
Scott Walker	N3SW	PA	ALL	< 5W		223	33	7	51513	Old Goats
Steve Whitton	K9IS	WI	ALL	< 5W		228	32	7	51072	
Larry Mergen	KØLWV	MO	ALL	< 5W	54	246	29	7	49938	
Randy Jones	K8ZFJ	RI	ALL	< 1W	42	176	27	10	47520	
Jose A. Gurutzarri	EA2IF	Spain	20	< 5W	50	243	26	7	44226	MONTeam
Jorge R. Daglio Accunzi	EA2LU	Spain	20	< 5W	51	240	26	7	43680	MONTeam
Michel Audette	VE2DJN/m	QC	ALL	< 5W	50	222	28	7	43512	
Donald C. Younger	W2JEK	NJ	ALL	< 5W	43	184	30	7	38640	
Hank Greeb	WQ8RP	Mi	ALL	< 5W		170	28	7	33320	
Charles Moiseau	W2SH	NJ	80	< 5W	55	221	20	7	30940	
Raymond A. Franz	WBØSMZ	KS	ALL	< 5W	37	167	26	7	30394	
Ronald V Chester	N6A	CA	ALL	< 5W	38	163	25	7	28525	
Arnold F. Olean	KØZK	ME	Hi Bands	< 5W	41	181	22	7	27874	
Bill Feidt	NG3K	MD	20/40	< 5W		155	23	7	24955	
John Farler	K4AVX	KY	ALL	< 5W		138	25	7	24150	
Mark Collins	KB5RXL	TX	ALL	< 5W	31	149	20	7	20860	
Dana A. "Mike" Michael	W3TS	PA	ALL	< 1W	25	113	18	10	20340	
Lee Dziekan	N8LJ	MI	ALL	< 1W	27	126	16	10	20160	milliwatters

two EA QRP ops were strong much of the time. The new fishing pole 3-el parasitic vertical array seems to help on 20m.—VA3RKM

Wish 20M had been more open. Wish some had tried 15M. Nice to have a KL7 answer my CQ as well as an EA.—W4QO

Wet weekend, nice for contesting. Thanks to all.—KD2JC

Conditions changed rapidly throughout the contest.—W4DU

First time with this contest, enjoyed it! —WA3WSJ

Glad to note increased 80m activity—K3HX

20m pretty much folded by sundown. 40m was the place to be. Skilled operators. —WØPQ

2009 QRP ARCI Fall QSO Party

NAME	Call	S-P-C	BANDS	POWER	#QSO's	Pts	SPC	Mult	Score	Team
Garry S. Nichols	WA1GWH	NY	Lo Bands	< 5W	29	127	21	7	18669	
Geoff Allsup	N1A	MA	ALL	< 5W		140	18	7	17640	
Don DiTullio	N1LU	NH	ALL	< 5W	27	126	20	7	17640	
Cam Hartford	N6GA	CA	20/40	< 1W		117	14	10	16380	milliwatters
Chuck Boblenz	AD6GI	CA	ALL	< 5W		132	17	7	15708	
Albert Britton	KIØJ	CO	20	< 5W		124	18	7	15624	
Jim Cluett	W1PID	NH	ALL	< 5W	27	122	18	7	15372	
Robert T Neece	KK4R	VA	20/40	< 5W		128	17	7	15232	
Derek Brown	WF4I	NC	ALL	< 5W		103	18	7	12978	Knightlites
Lynn Hammond	KL7IKV	AK	20	< 5W	23	97	18	7	12222	
Pat Byers	VE3EUR	ON	ALL	< 5W	20	91	19	7	12103	
Bill Schmidt	WV1N	CT	ALL	< 5W		113	15	7	11865	
Adrian Weiss	WØRSP	AZ	20	< 5W	23	106	15	7	11130	
Edwin E. "Ted" Albert	AB8FJ	OH	ALL	< 5W	17	85	16	7	9520	
Francis R. Dill Jr	WA3GYW	MD	ALL	< 5W	19	91	14	7	8918	
John Graf	WA6L	CA	20	< 5W	20	94	13	7	8554	
Jay Mathisrud	WBØL	MN	ALL	< 5W	16	77	15	7	8085	
Stephen Putich	W2MY	TX	ALL	< 5W	18	84	12	7	7056	
Joe White	WA4GIR	NC	ALL	< 5W		77	13	7	7007	Knightlites
Kelly McClelland	K4UPG	FL	20	< 5W		88	11	7	6776	
William Ravenel	AI4VE	NC	20/40	< 5W	16	80	12	7	6720	
John Paul Keon	AB4PP	NC	ALL	< 5W		70	13	7	6370	Knightlites
John T. Collins	KN1H	NH	80	< 5W	19	81	11	7	6237	
T.J. "Skip" Arey	N2EI	NJ	40	< 5W	16	71	12	7	5964	
Michael Babineau	VE3WMB	ON	ALL	< 5W		70	12	7	5880	
Alan Skerker	KC4ZA	VA	20/40	< 5W	14	67	12	7	5628	
John Parnell	K7HV	WA	20	< 5W	15	69	11	7	5313	
Joe Spencer	KK5NA	TX	20/40	< 5W	14	67	11	7	5159	
Terry A. Bachmann	W9UX	WI	20/40	< 5W		64	11	7	4928	
John Watkins	NØEVH	MO	20/40	< 5W		51	12	7	4284	
Tony Ploski	W2HWW	NJ	ALL	< 1W	10	47	9	10	4230	
Edward A. Kwik, Jr	AB8DF	MI	20/40	< 5W	12	60	8	7	3360	
Paul Neuman	KD2MX	NJ	20/40	< 5W	11	51	9	7	3213	
Curt Hulett	KB5JO	TX	20/40	< 1W	11	40	8	10	3200	
Norman Brooks	WF7T	TN	20/40	< 5W	9	45	9	7	2835	
Joseph Plesich	W8DYF	OH	ALL	< 5W	10	50	8	7	2800	
Michael McShan	N5JKY	OK	20/80	< 5W	10	47	8	7	2632	
Paul Huff	N8XMS	MI	20/40	< 5W	11	52	7	7	2548	
Kevin McCall	KCØJBU	CO	20	< 5W	9	42	7	7	2058	
Michael Newland	N4JRG	KY	20/40	< 5W	7	35	6	7	1470	
Will Bowser	K9FO	IL	20/80	< 5W		26	7	7	1274	
Calvin Benoit	VA3BLP	ON	40	< 1W	5	25	5	10	1250	
Chris Brakhage	WB5FKC	TX	40	< 250mW	3	15	3	15	675	milliwatters
Drew Arnett	KB9FKO	CA	20	< 5W	4	20	4	7	560	
Walt Robbins Jr	WA9ZES	IN	20/40	< 5W	4	20	3	7	420	
Brain Waddell	GM4XQJ	Scotland	20	< 5W	3	15	3	7	315	
Paul Quillen	N4LCD	GA	20/40	< 5W	3	12	3	7	252	
Javier	EA2BVV	Spain	20	< 5W	1	5	1	7	35	MONTeam
Robert Keller	KC8FNF	OH	20	< 5W	1	5	1	7	35	
Aage Groseth	LA1ENA	Norway	20	< 5W	3	11	2	7	Checklog	
George Tibbetts	KF4UCC	VA	20/40	< 5W	12	57	12	7	Checklog	
Gary Wikstrom	CU2JT	Azores	20	> 5W	1				Checklog	

Looked on 80, 40 & 15 but all the action was on 20m from Colorado—KF7MD

Condx were not as good as previous ARCI contests, but enough stations were hearming my 50 mW to keep things interesting. Noise conditions on 80m pretty well wiped out any chance of anyone hearing me there (except for WA3WSJ). KT5E (CO) demonstrated great ears by plucking my 40m signal out fo the ether Sat night. It was great fun sharing hte shack with fellow milliwatter Dick W4HAY and operating with "The Milliwatters" team.—AA4XX

I found the condx surprisingly good. I was somewhat distracted by learning N1MM contest logger but the good news is now I am familiar with that program. 20m was good for me and I enjoyed working the CA stations on 250mW. Thanks to my

fellow milliwatter Paul, AA4XX for allowing me to share the experience in the shack. —N4HAY

Nice to work EA2LU, and thanks to K9JWV(UT) for 50th state via QRP CW.— AI2T

I had a great time in the contest. I operated 20m from the back yard with a dipole hanging in the trees. When the mesquitos started trying to carry me away and went inside and operated 40m with my 40m EFHW configured as an Inverted-L. 20m seemed very good on Saturday and I spent most of the time on 40m Sunday. I couldn't find much actvity Saturday night so I ended up working QRP in the pre-Stew Perry Contest on 160m where my antenna is about –20 dBi, or worse. I still managed 6 QSOs with one over 1,300 km!—AA5TB

High noise level on all bands. Slug out with NY QSO party nearby!—WR4I

Another tough one! Lots of empty time between QSOs. Well....next time! Thanks for all of the QSOs.—WA5RML

Struggled mightily to make one contact on 15m. Finally was able to work N4BP. Atmospheric noise was high on 40m and 80m.—W5ESE

Activity level very low, heard some interesting DX on 20 but no QSOs—KØLWV

That was fun! My ears hurt; need more comfy headphones.—K8ZFJ

My first QRP contest, is hard, but relaxing. I am very surprised to work few stations with Milliwatts from USA, also, West coast and KL7IKV from Alaska. Excellent experience I promise to be QRV on the next Spring QSO Party.—EA2LU

Nice contest, but everything folded about midnight Saturday. Where were the night owls? Got tired of working NYQP Stations, which were numerous on 80m. Heard others calling them, so conditions were great to many parts of the country.—WQ8RP

Best 80m "DX" was NJ to MN, 985 miles, occurred just at my local sunset on second evening when condx were much better than the night before.—W2SH

Very rough conditions.—WBØSMZ

N6A was a special event callsign celebrating the 5th anniversary of the North American QRP CW Club.—N6A

Portable, battery powered from front seat of VW Beetle parked at Parsons Beach, Kennebunk, Maine.—KØZK

First chance to fully try out the ATS3 built for me by Roger K7RXV, and it worked well on 80 and 40. I never did get very good band conditions on 20 however. Had a great time after being off the QRP contests for a while, and worked 8-10 state QSO party stations, also.—K4AVX

Short operating time, but great fun, especially last hour run. Operated under the NAQCC 5th Anniversary special event call N1A.—N1A

Heard EA2LU/QRP at noise level, but unable to complete QSO. Many tnx to all for your patience and excellent ears. Hope to cu next test.—AD6GI

Maritime Mobile.—KK4R

Low participation, poor propagation & the NY State QSO Party made QSOs challenging. —WF4I

This was the most participation I've made in a contest in several years and, although my score is modest, I'm pleased with the result. I was testing out my new QTH and wringing out two rigs: NC2030 for 20m and 2N2/40. Both worked very well. Their outstanding receivers performed very well in this high QRN environment. The quality of the ops in these QRP contests continues to impress me. Lots of digging required for many of the contacts. Many thanks to Bob, VA3RKM, for QSOs on all 6 bands! Oodles of fun at this end and can't wait for the next one.—VE3EUR

This was the first QRP contest that felt like a contest. I'll be back next year.—WV1N

Just moved to AZ & finally put up the SD Resonant Vert (*QQ* Apr 2001?) with only 9 radials. 20m pretty good when ops were on.—WØRSP

The propagation was much better. I worked more than I thought. The active filter helped!—WA3GYW

It has been a long time since I have been on the air. It was very nice to work the old timers I knew in the past.—W2MY

Very noisy contest this time. NYQP took over bands and had a hard time copying a lot of stations with QRM and poor propx. Hopefully next one will be better. We did have a good time in the woods and the fellowship was well worth the trip. Weather cooperated this time and we only had a brief shower on Sunday when tearing down.—AB4PP

Fun but tough to work under the New York QSO Party. Single band this year—N2EI

Lots of QSB. Only on the air on Saturday for a few hours due to a bad cold. —VE3WMB

Here is my log for your VFB ARCI QRP contest. This was great fun; I will join ARCI immediately! Two way QRP is wonderful... —K7HV

Great event mixed with the NY QSO Party and IL QSO Party, I made about 40 contacts that weekend.—KK5NA

Family activities kept me scrambling all weekend to get on the air. An hour here or there with three different radios so I could at least make a few Qs.—NØEVH

Only had a little time to work on Sunday. Highlight of the day was working 2 EAs. QRP DX has been as rare as sunspots.—KD2MX

It was fun! Next time I'll put more time in. N4BP had a huge signal!—W8DYF

I didn't get much free time during the weekend to operate the contest but did manage to make a few contacts. The band seemed to be in poor shape here in the middle of the country.—N5JKY

I didn't really work the contest but I did make a few contacts between chores, football games, etc.—N8XMS

Working 3 contests at once!—K9FO

Getting back on the air from years off. First ARCI contest since fall of '97. Didn't get to spend too much time, but had a lot of fun. —KB9FKO

This was my first CW contest. Wish I had more time to play. Looking forward to next time.—KC8FNF

Mark Your Calendars!

3 & 4 April 2010:
Spring QSO Party

30 May 2010:
Hootowl Sprint

26 & 27 June 2010:
milliWatt Field Day

FOR ALL CONTESTS:

Email Log Submission:

Submit Logs in plain text format along with a summary stating your Callsign, Entry Category, Actual Power and Station Description along with score calculation to va3jff@yahoo.ca

Snail mail Log Submission:

Submit Logs along with a summary stating your Callsign, Entry Categorym Actual Power and Station Description along with score calculation to:

(Contest Name)
c/o Jeff Hetherington, VA3JFF
139 Elizabeth St. W.
Welland, Ontario
Canada L3C 4M3

Results will be published in *QRP Quarterly* and shown on the QRP-ARCI website. Certificates will be awarded to the top scoring entrant in each category, as well as the top scoring entrants from each State, Province and Country. Certificates may be awarded for 2nd and 3rd place if entries are sufficient in a category.

2010 QRP-ARCI Spring QSO Party

Date/Time:

1200Z on 3 April 2010 through 2359Z on 4 April 2010.
You may work a maximum of 24 hours of the 36 hour period.

Mode:

HF CW only.

Exchange:

Members send: RST, State/Province/Country, ARCI member number
Non-Members send: RST, State/Province/Country, Power Out

QSO Points:

Member = 5 points
Non-Member, Different Continent = 4 points
Non-Member, Same Continent = 2 points

Multiplier:

SPC (State/Province/Country) total for all bands. The same station may be worked on multiple bands for QSO points and SPC credit.

Power Multiplier:

>5 Watts = x1
>1 - 5 Watts = x7
>250 mW - 1 Watt = x10
>55 mW - 250 mW = x15
55 mW or less = x20

Suggested Frequencies:

160m	1810 kHz
80m	3560 kHz
40m	7030 kHz (also 7040 kHz for rock bound stations)
20m	14060 kHz
15m	21060 kHz
10m	28060 kHz

Score:

Final Score = Points (total for all bands) × SPCs (total for all bands) × Power Multiplier.Mulitoperator:

Teams:

You may enter as a team with an unlimited number of operators as long as no more than 5 transmitters are on the air concurrently. You compete individually as well as on the team. Teams need not be in the same location. Team captains must send a list of members to the Contest Manager before the contest.

Entry Categories:

Entry may be All-Band, Single Band, High Bands (10m-15m-20m) or Low Bands (40m-80m-160m)

New for 2010!

A multioperator effort may submit logs in a new separate category. Any combination of operators and transmitters will be permitted. All transmitters must be located at a centralized location. All operators must use the same callsign in the multioperator category.

How to Participate:

Get on any of the HF bands except the WARC bands near the QRP frequencies. Work as many stations calling CQ QRP or CQ TEST as possible, or call CQ yourself! Work a station for credit once on each band.

Entry Deadline:

Entries must be postmarked on or before 4 May 2010.

2010 QRP-ARCI Hoot Owl Sprint

Date/Time:

8 pm to Midnight LOCAL TIME on 30 May 2010.

Objective:

To test your ability to make contacts late into the evening local time.

Mode:

HF CW Only.

Exchange:

Members send: RST, State/Province/Country, ARCI member number
Non-Members send: RST, State/Province/Country, Power Out

QSO Points:

Member = 5 points
Non-Member, Different Continent = 4 points
Non-Member, Same Continent = 2 points

Multiplier:

SPC (State/Province/Country) total for all bands. The same station may be worked on multiple bands for QSO points and SPC credit.

Power Multiplier:

>5 Watts = x1
>1 - 5 Watts = x7
>250 mW - 1 Watt = x10
>55 mW - 250 mW = x15
55 mW or less = x20

Suggested Frequencies:

160m	1810 kHz
80m	3560 kHz
40m	7030 kHz (also 7040 kHz for rock bound stations)
20m	14060 kHz
15m	21060 kHz
10m	28060 kHz

Score:

Final Score = Points (total for all bands) × SPCs (total for all bands) × Power Multiplier.Mulitoperator:

Bonus Points:

If you are operating PORTABLE using battery power AND a temporary antenna, add 5000 points to your final score. (You can NOT be operating from battery power using your home station antenna.) This is to help level the playing field for contesters who work from the field against contest stations at home with 5 element yagis at 70 ft.

Entry Categories:

Entry may be All-Band, Single Band, High Bands (10m-15m-20m) or Low Bands (40m-80m-160m)

How to Participate:

Get on any of the HF bands except the WARC bands near the QRP frequencies. Work as many stations calling CQ QRP or CQ TEST as possible, or call CQ yourself! Work a station for credit once on each band.

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and follow the instructions. Be sure to select the appropriate button for the area of the world you reside in (US, Canada, or DX). International members may send payment by check directly to the club Treasurer, but ... ***funds must be drawn on a U.S. bank and be in U.S. dollars.*** Make checks payable to: **QRP ARCI**.

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